# THE MODEL ENGINEER

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# The MODEL ENGINEER

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4TH JANUARY 1951 VOL. 104 NO. 2589



# SMOKE RINGS

## Our Cover Picture

● WE THINK that we are safe in assuming that this week's cover picture will have caused surprise to most of our readers. The eastern end of St. Paul's Cathedral, London, was badly damaged during the heavy air-raids on the city during the war, and the necessary repairs will require a very long time to complete. So the photographs from which the illustrations on our cover and on the next page have been reproduced, do not show the actual work completed, but a model of what it will look like when it is finished.

This remarkable model, one of the most perfect of its kind yet constructed, was made by Messrs. J. B. Thorp, of Gray's Inn Road, who are specialists in this particular type of model making. It is to the scale of 1 in. to the foot, large enough to ensure the exact reproduction of relevant detail; and we leave the pictures to speak for themselves. But we feel that they make a sufficiently striking start to a new volume.

## Old Model Steamboats

● MR. J. H. AHERN, the well-known model railway expert, has informed us that, when his wife and he were browsing through a volume of *The Illustrated London News* for the year 1860, recently they came upon an advertisement reading:

NEW SMALL STEAM-BOATS for Ponds, carriage free 4s. 6d. and 5s. 6d. Length, 13 in., propelled by steam about the speed of a rowing-boat.—JAS. PARKER, Inventor, 6, Lilford-road, Camberwell.

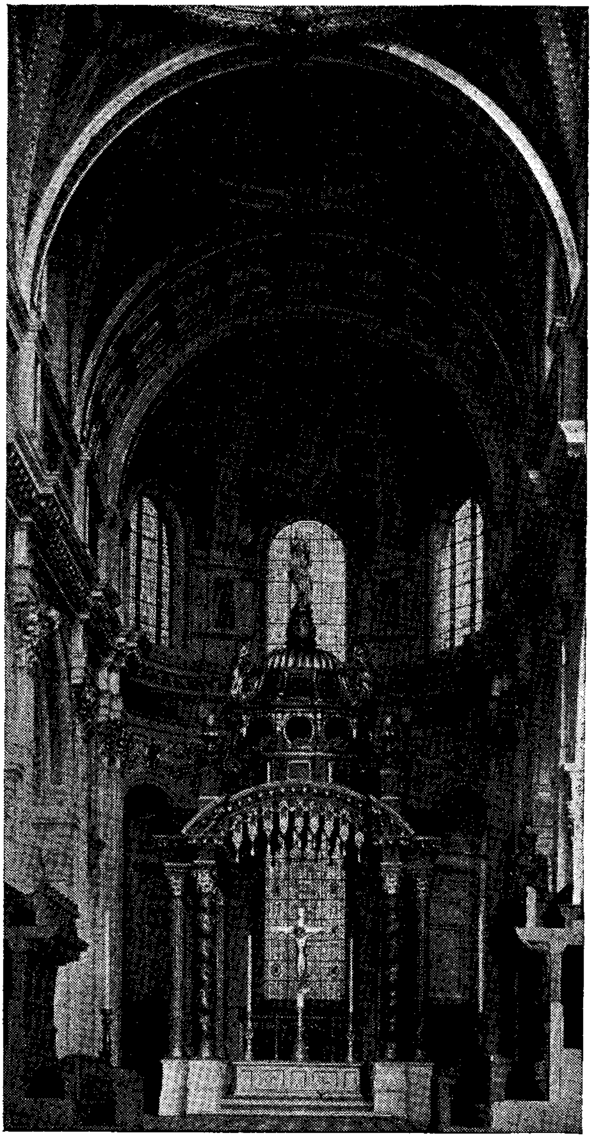
Mr. Ahern imagines that this must have been the first attempt to produce any sort of steam-driven model commercially at a popular price or, indeed, at any price at all! It would be very interesting to know if any further records exist of Mr. Jas. Parker, or if any models or toys exist which might be attributed to him.

## Another Old Toy

● MR. G. E. MORTLEY, of Tunbridge Wells, who became a subscriber to THE MODEL ENGINEER in 1898, beginning with Vol. 1, No. 8, reminded us some time ago of a rather remarkable toy which he possessed in 1892. It was a German-produced model fire-engine which had a pressed steel boiler, with a cork inside the chimney, acting both as a filler and a safety-valve. The cylinder, presumably of lead-tin alloy, was of oscillating type, and there was a single-acting pump, an air-vessel, suction and delivery hose, spirit-lamp, etc. The model could be self-propelled to the scene of the fire (two or three empty match-boxes!) and would then throw a tiny jet of water a couple of feet or more. These engines were imported and marketed by a firm named Theobald and, if memory serves correctly, they were retailed at 1s. 6d.

This seems incredible; but since shining brass locomotives with 2 oscillating cylinders, safety-valve, whistle, regulator and lamp were sold at prices from 4s. 6d. to 6s. 6d., perhaps the price of the fire-engine is not so surprising, after all.

## The Price of Knowledge!



● A LADY rang up the "M.E." offices recently and asked for some advice in the selection of literature which was presumably intended as a present for a mechanically-minded relative. A number of suggestions for suitable books was given, and the subjects appeared to be acceptable, but on being told the price of these books, the opinion was expressed that they would be much too cheap to give as a Christmas present! It is, perhaps, a very human fallacy to judge values by the standard of price, but we think many of our readers will agree that this does not always apply in true proportion in respect of technical literature. We know of many successful model engineers who received their first and perhaps most valuable lessons in model engineering and mechanical work from the early 6d. edition of the "M.E." series of handbooks. Although modern economic conditions make it impossible to publish books at such a price nowadays, it is still our firm policy to supply amateurs with sound information at the very lowest possible cost, and we have plenty of evidence that this policy is appreciated, and taken full advantage of by many engineers, both amateur and professional.

## Boycotting the Amateur

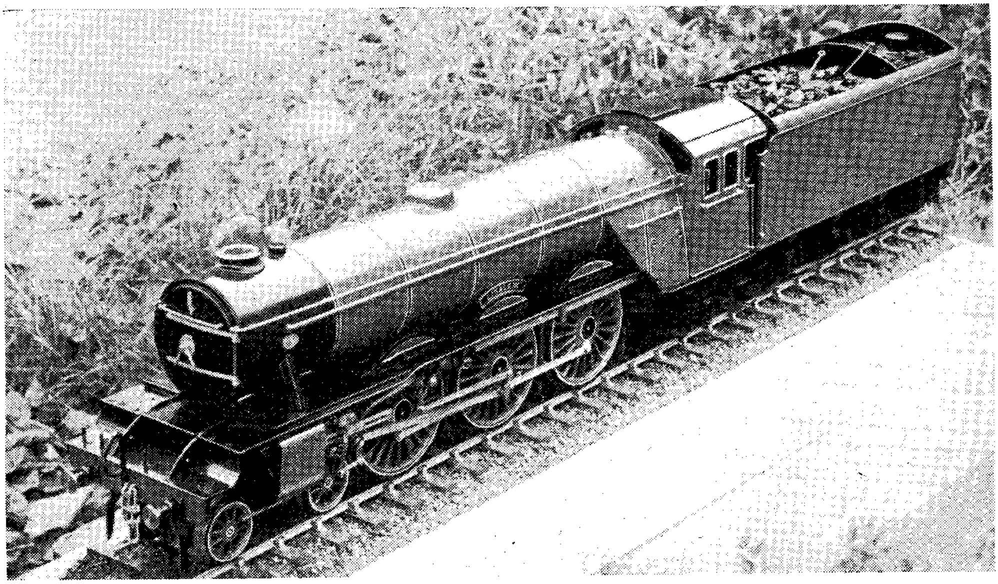
● ONE OF our readers, who has produced very many fine examples of craftsmanship in horological work, informs us that there is a move in the clock and watch trade to prohibit the supplies of materials to anyone other than *bona fide* professional tradesmen. If this is indeed the case, we feel very strongly that it represents a very short-sighted policy which, like most restricted practices, may defeat its own object in the long run. The professional watch or clock maker, if he is a competent craftsman, need fear nothing from competition with the amateur who, in the great majority of cases, is not interested in the financial side of this work, but produces clocks simply for the love of craftsmanship. It is true that there may be a few amateur or semi-professional workers who carry out botched-up repairs, and not only introduce black-leg competition, but also tend to lower the standards of the industry. These are in the minority and are soon found out by the poor quality of their work. There are very many amateurs who are capable of producing a clock from raw material to the finished product, including the cutting of wheels and pinions, casting of bells, making and engraving tools, fretting the hands, etc., not to mention the cabinet work, and examples of their work has often been exhibited at "M.E." Exhibitions. The professional craftsman may often be prevented by purely economic reasons from producing quite the same kind of work, but if he has true craftsmanship at heart, he need never fear that his living will be jeopardised by the activities of the amateur.

## Our New Year Wish

● WE TAKE this opportunity of wishing a Happy New Year to all readers, advertisers and contributors. We hope that, although difficulties may still beset us all, the true spirit of our hobby may transend all set-backs and annoyances that may impose themselves upon our pleasures.

# "LISALEIN" — Made in Germany

by Richard R. Marsh (B.A.O.R.)



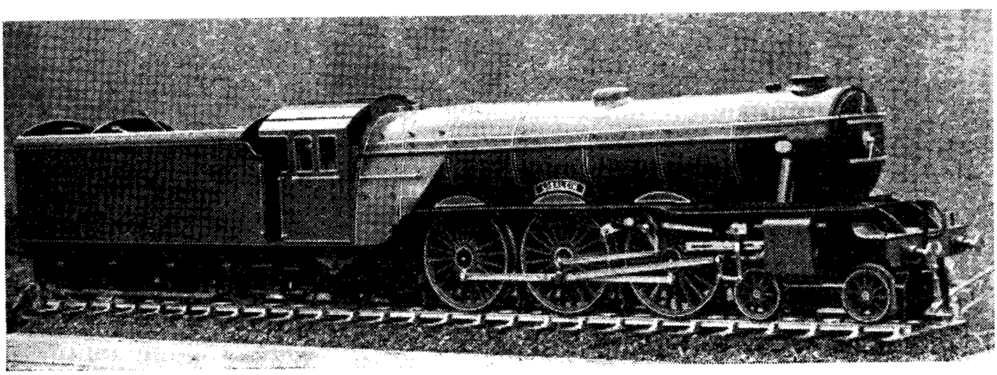
MAY I introduce you to *Lisalein*, my ½-in. scale, 2½-in. gauge, *ex*-L.N.E.R. Pacific? I may! Thank you so much.

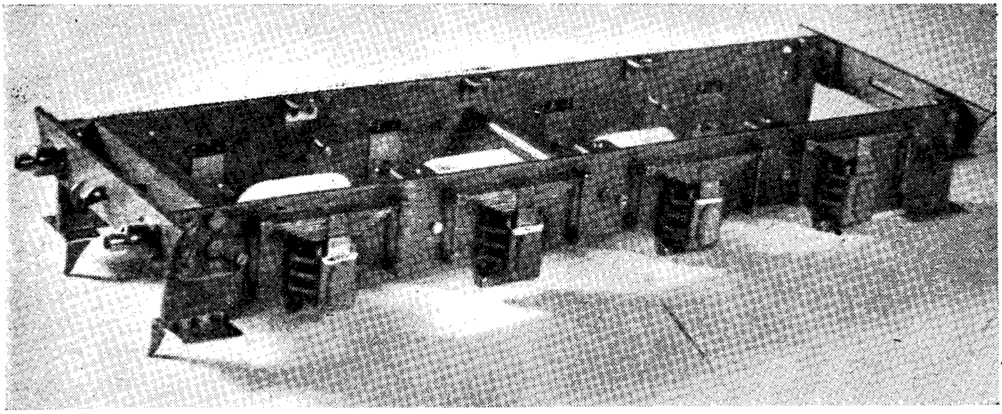
Well, to start with, the accompanying photographswill enable you to become better acquainted. Observe that rather smug, self-satisfied expression on her smokebox front as she sits on her rails contemplating her surroundings.

Oh, yes! she can look like that now, but, between ourselves, she has been responsible for much trouble in her teething days, but the adoption of a very determined approach to her complicated idiosyncrasies soon put an end to this ignominious behaviour. My mind was made up; I was firmly resolved in my purpose of being the proud possessor of one small edition *ex*-L.N.E.R. Pacific before the species finally died out.

Work was started in August, 1948, but, as already pointed out, did not go as well as expected because three sets of main frames eventually found a resting place in the scrap-box before I was aware that a start had been made at all.

I would like to mention at this point that the inspiration for this model arose from two sources, the first being my desire to own my only edition of a model L.N.E.R. Pacific. The second, and most influential source, was the contemplation





*The main frames*

by my workshop mechanic, Herr Rudolph Blobaum, of the front cover of an old edition of THE MODEL ENGINEER, depicting Mr. Tom Aitcheson's very neat $2\frac{1}{2}$-in. gauge L.N.E.R. Pacific. Herr Blobaum suggested that we should attempt a model on the same lines as Mr. Aitcheson's, to which I was forced to agree.

It may be of interest to note that no drawings were used to obtain the proportions of the superstructure or general outline, all dimensions having been obtained by the simple process of scaling up a three-quarter view photograph of one of the old A1-class Pacifics. The object throughout the construction of this model was not to copy the photographical Pacific exactly as it appeared, but rather to use the photograph as a guide to the general shape and proportions of one of the A2-class locomotives fitted with corridor tender (details of which I was fortunate enough to find in an old magazine).

It is realised, of course, that *Lisalein* is not even a true reproduction of any one of the noble Pacifics, but rather possesses a personality all of her own, due to the whims of her constructors who had decided on a few minor modifications without mutilating the finished product too much. However, we have endeavoured to keep the general appearance as neat as possible without impairing her working, because, as "L.B.S.C." advocates, it is not so much the appearance as the performance which really matters. Mention of "L.B.S.C." brings me to another point, namely, that although *Lisalein* may be reminiscent of "Gresley," the parts that really matter are just pure "L.B.S.C."; and I can honestly say that, without the great help obtained from his articles, this model would have been a complete failure.

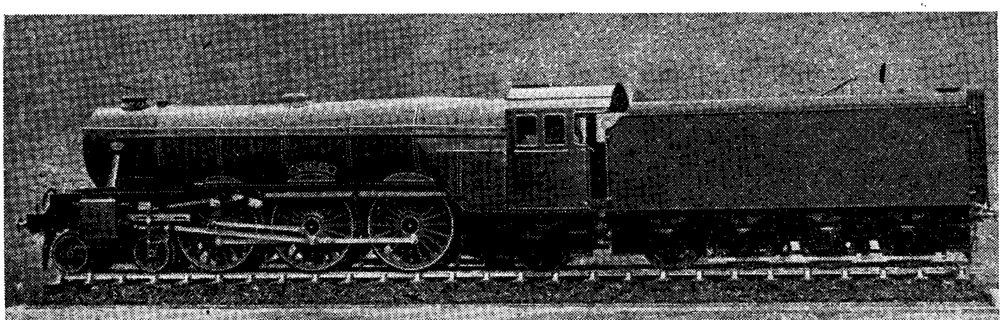
*Lisalein* is equipped with three piston-valve cylinders fitted with $\frac{5}{16}$-in. bobbins; the middle cylinder valve derives its motion from independent Walschaerts gear instead of the conventional two-to-one motion fitted to the prototypes.

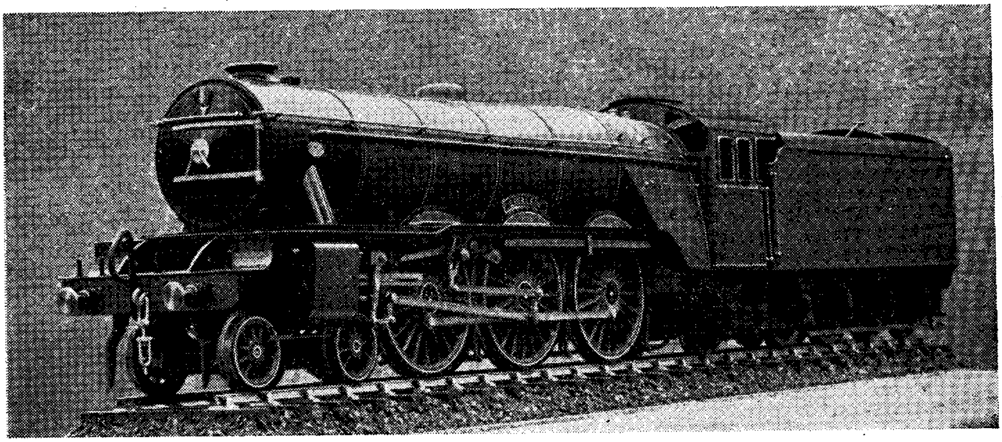
Lubrication is efficiently effected by means of mechanical and displacement lubricators; the former attends to the outside and steam brake cylinders, the latter feeding inside cylinder only.

As mentioned, the locomotive is fitted with fully compensated brake gear, steam operated and a delight to observe in action.

Water feed is by means of injector and axle-driven pump, both components having been made exactly to "L.B.S.C." instructions, and give excellent results.

To anyone who cannot make a successful injector from "L.B.S.C.'s" specifications I can only say: "Read that chapter on injectors once more," because I have never constructed anything like an injector in my life before and was so delighted with the results that I constructed a





further four after my first, all of which would have lifted a house. These were presented to other members of our fraternity, incidentally.

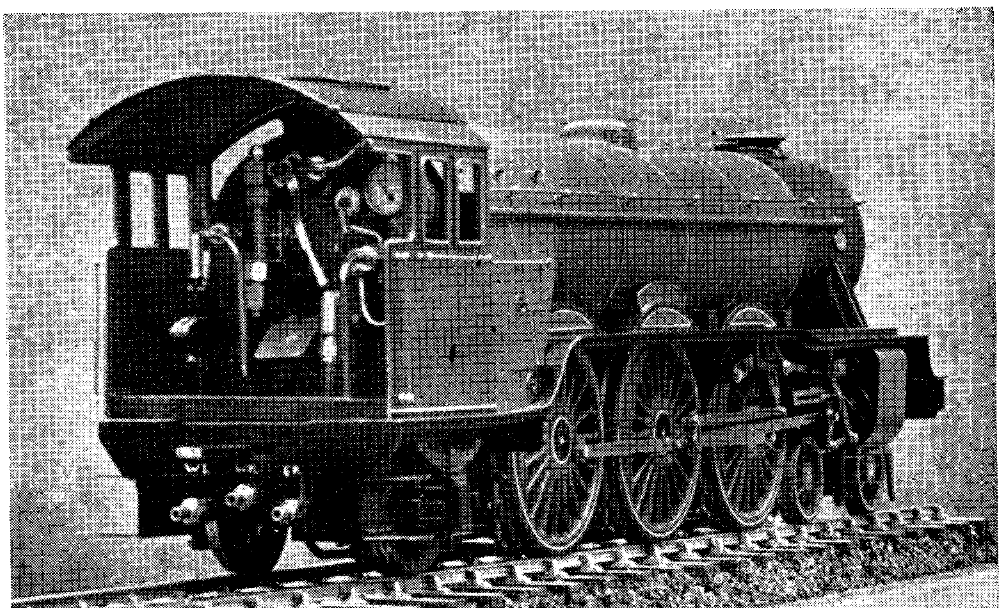
Of great joy to me are the unfailing efficiency of the snifter valve, which really snifts, and the bark of the exhaust which tends to part the chimney from the smokebox. The boiler is fitted with a combustion-chamber containing four water-tubes to assist circulation, two spearhead superheater tubes and eight flue tubes, a combination which gives plenty of steam with enough to spare. The boiler was the work of Herr Blobaum who was also responsible for part of the superstructure and tender frames.

*Lisalein* has given us both so much pleasure during the course of her construction that we are now resolved to build a little companion for her in the form of a fussy little tank by name of *Tichlein* !

Photographs were taken by Mr. F. Thomas, A.R.P.S. The entire construction of the model was undertaken in the Army Kinema Workshop, Training School, B.A.O.R. 1.

Work was commenced August, 1948 and completed in July, 1950.

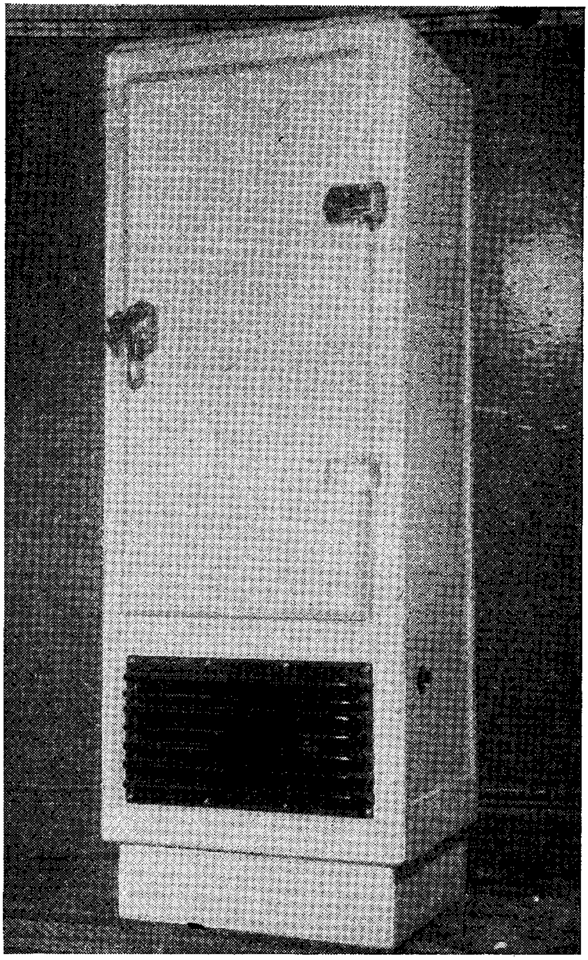
I would like to close by saying that the great part played by THE MODEL ENGINEER in expanding our outlook and knowledge on a subject which has advanced so rapidly in all its aspects (model engineering has, I believe, almost unlimited barriers) during the past few years, is a part that has been most effectively responsible for the growing interest in our most attractive hobby.



*Showing the cab fittings*

# A Domestic Conversion

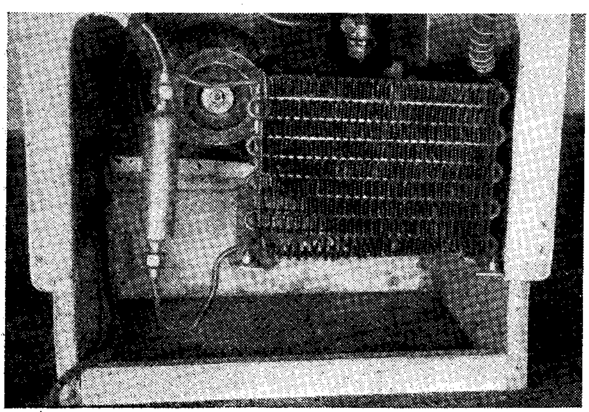
## by J. V. Edwards



*The finished job*

AFTER reading Mr. Sherrell's excellent description in THE MODEL ENGINEER of December 1st, 1949, of the building of a domestic refrigerator, I decided that I would attempt to build one myself as a change from my normal activity of building model race cars. I was assisted in making up my mind on the matter by my wife, who considered that I would be making something really useful!

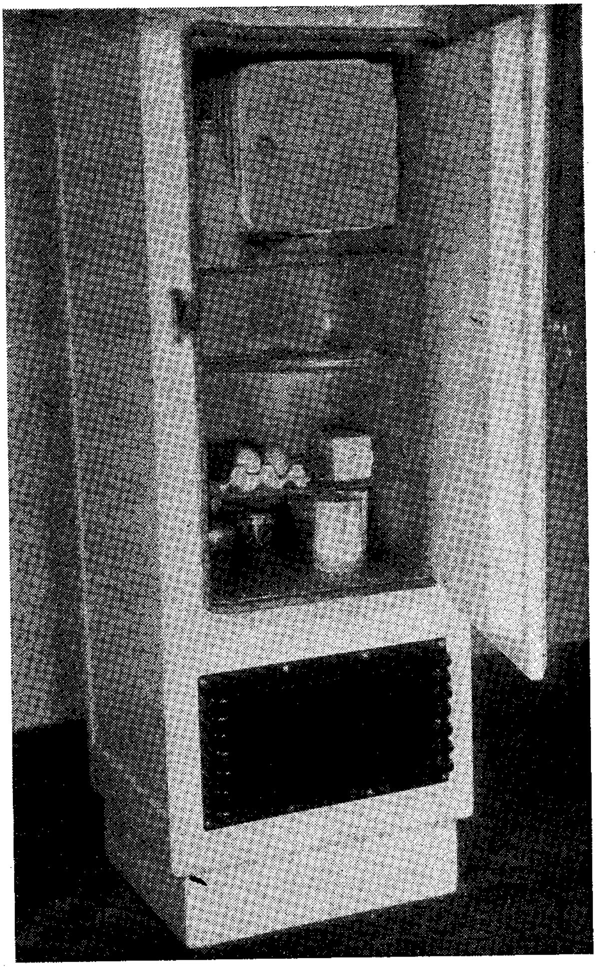
The cabinet itself was originally a food cupboard of the type which is to be seen in any of the large department stores. The one we had was bought about four years ago, and after taking it carefully to pieces I made a rough dimensional plan of it and found I could fit an inner cabinet 15 in. × 15 in. × 30 in. Due to my having a main wooden cabinet to start on, the rest of the various parts were made to suit the fixed dimensions of it, using Mr. Sherrell's plans as a very useful guide. The inner cabinet was made in separate pieces; sides, back, top and bottom being riveted with $\frac{1}{8}$ in. diameter aluminium rivets to $\frac{3}{4}$ in. × $\frac{3}{4}$ in. aluminium angles at each corner. The outer edge was flared out to mate up with a bevel which I had made on the front supports of the wooden frame; it was then secured with chrome wood-screws and cup washers.



*Motor compartment (rear), showing drier (Silica gel) and condenser*

After making and fitting the supports for the trays, a wooden shelf was fitted 4 in. below the inner cabinet. It was made from $\frac{5}{8}$-in. thick timber, the full depth of the frame, and securely screwed to the uprights.

The next job was to make the evaporator. This was made from 18-gauge mild-steel plate and is $8\frac{1}{2}$ in. × $8\frac{1}{2}$ in. × 9 in. deep with 1 in. radius corners. The back is soft-soldered and riveted on with $\frac{1}{8}$ in. diameter soft-iron rivets. 22 ft. 6 in. of $\frac{3}{8}$ in. o.d. copper pipe was then annealed in two lengths and the soft-soldering of it on to the evaporator commenced. I was very ably assisted in this by my wife! The method used after getting my blowlamp going, was to lay the copper pipe up against the flange which forms the door stop,



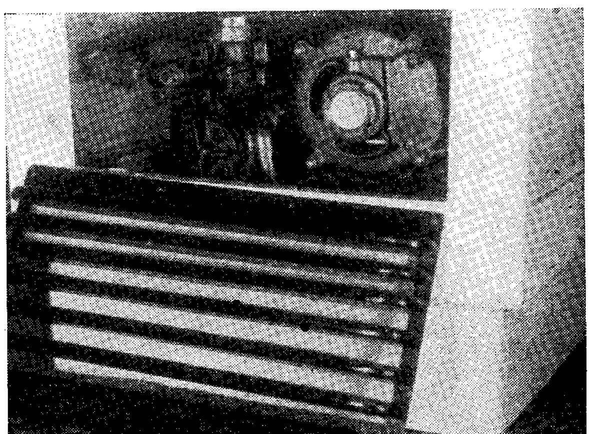
*View of interior, showing ample shelving space*

leaving 2 ft. spare for connecting up outside the cabinet. After applying spirits of salts, the tube was heated up and solder applied, being allowed to run right underneath the tube. After fixing one side, the tube was bent firmly round the 1 in. radius corner and the next side soldered in a similar fashion. When one length of the tube had been soldered on, the end of it was flared out with a punch and die and the end of the second length was pushed in and silver-soldered into position. After dressing up the fillet, the remaining tube was wrapped round and soldered. The tube is spaced $\frac{3}{4}$ in. apart and a further 2 ft. left at the other end for connections. These two ends are coupled on to the expansion valve, and one, which is the return pipe, goes out through the back of the inner container down to the suction side of the compressor.

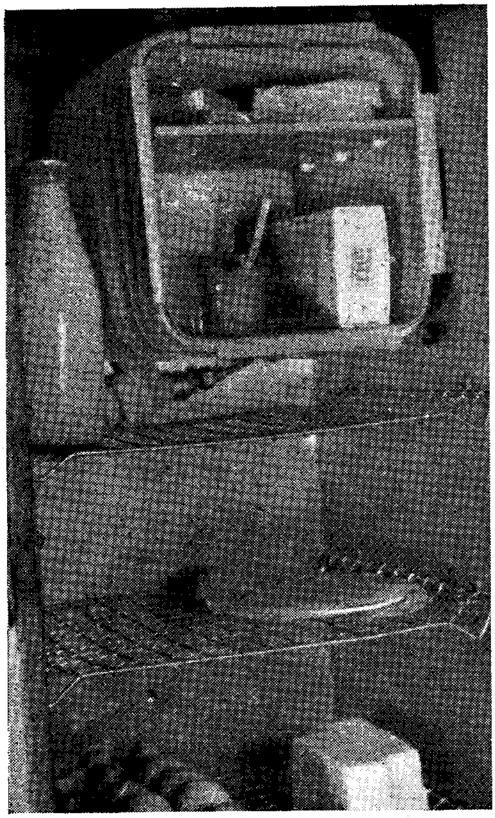
The expansion valve is a "Teddington" product (type O.N. 041). I mention this because this one is the second valve which I have fitted, the first being the wrong type for a small type refrigerator and more suitable for a larger type. The compressor is a "Kelvinator" which I bought at an *ex*-W.D. auction. It was brand new and presumably was originally intended to be part of the spares of some R.A.F. unit. I obtained the condenser from the same source, but this had, unfortunately, been knocked about somewhat. I soon had it looking like new again by using a screwdriver to open out the gills on the tubes which had been completely flattened in one spot. The compressor, $\frac{1}{4}$ b.h.p. motor, and condenser, are mounted on a $\frac{1}{8}$ in. thick mild-steel plate 18 in. × 10 in., the whole unit being suspended by coil springs hooked on to two $\frac{7}{16}$ in. diameter rods which pass through the front and rear uprights. This damps out all sound and vibration, the only sound, apart from the faint hum of the motor, being the click of the centrifugal switch in the motor itself.

The thermostatic switch is fitted on the lower right-hand side of the cabinet and the tube runs up through the insulation into the cabinet and fits snugly between the last two coils of the evaporator. This switch was also *ex*-W.D. Presumably it was intended for a deep-freeze unit, as it is calibrated down to —20 deg. F., but luckily there is a knurled adjusting screw inside, which after trial and error has been finally set to maintain a reasonable degree of frost on the coils.

The insulation of the cabinet is of



*Motor compartment (front) with grille removed*



*Ready for defrosting*

fibre-board, ½ in. thick, and tightly compressed wood wool sewn into flat packets. The packets were made by my wife out of strong wax paper; filled, and sewn up all round. The total thickness of the insulation is approximately 2¾ in. at the sides and back, and 4 in. at the top and bottom.

The charging of the unit presented no difficulty, even though I had never attempted it before, but I followed the instructions of Mr. Sherrell, except that I found I required slightly more methyl chloride (approximately 1¾ lb.) to completely frost up the coils.

The refrigerator has been running continuously for some months and, except for defrosting, has given no trouble at all so far.

The facts and figures of this home-made refrigerator are as follows :—

Average running time, 1 min. on, and 4 min. 45 sec. off, giving an all-round figure of approximately 12 min. total running time each hour; this improves considerably after the coils become really frosted.

The evaporator, being completely closed in, will freeze solid 24 "lollies" (for my son's benefit) in 90 min.

Time taken in accomplishing this conversion was approximately 200 hrs. spread over the evenings and weekends of 13 weeks.

Total capacity of cabinet 3¾ cu. ft. approximately.

Although I am an engineer by trade, refrigeration was something which I had taken for granted until I had to find out exactly "What made the wheels go round," as "L.B.S.C." would say. It has certainly been worth doing and I would like to take this opportunity to thank my two friends, Mr. Moss and Mr. Williams, for their help and guidance, and also Mr. Pilling for the photographs.

With the Editor's permission I will gladly furnish any further details to readers who may require them, and if any readers in the Manchester area would care to examine the finished job, they will be made quite welcome provided they notify me by post beforehand.

# Bench-Mounting a Lathe

THE writer has a 3⅛-in. lathe of the cantilever type and has what appears to be a very robust main casting. It is supported on two hardwood blocks and secured to a heavy wooden bench by bolts which pass through these blocks and the 2 in. planking of the bench. Slots are cut in the bench to allow of belt adjustment, the belt drive is horizontal.

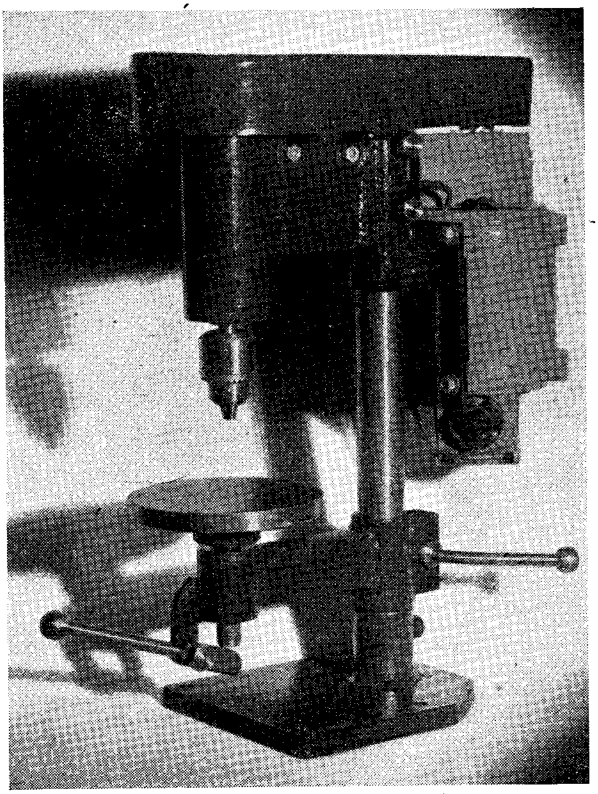
A few days ago, when facing a large steel disc, I had occasion to tighten the belt: I had already begun to traverse the tool inwards preparatory to taking a new cut when I decided to do so. Having tensioned the belt and the bolts at the headstock end, I proceeded to tighten those nearer the tailstock with the lathe still running. As I did so I noticed that the tool, which I had not withdrawn from the work, touched or did not touch this. This, of course, indicated wringing of the lathe bed, and something to be investigated.

Later on I inserted a bar in the lathe, as long as could normally be turned in it, and slacked off all holding-down bolts. I then applied a test indicator to the tailstock end of the bar. Tightening the bolts at the headstock end caused no movement of the indicator, as was to be expected, but a movement of ten thousandths of an inch could easily be produced by alternate tightening of the other two bolts, even when these had already been tightened enough for normal working.

As I have stated, the main casting is, apparently, of very heavy construction, but is unfortunately not built, in my opinion, in the best way to resist torsional stress. There are, of course, difficulties in producing a casting which would do so.—H. G. SHARPE (Argentine).

# A Model Engineer's Light Drilling Machine

### by "Midlander"



*The completed drilling machine*

I FIRST felt the need for a small drilling machine when I found that I had a number of small holes to drill (No. 59), and that my 0 to $\frac{1}{2}$ in. Progress drill chuck would not take this size of drill.

I remembered seeing a small drilling machine in a London shop when visiting an "M.E." Exhibition, and having memorised the design, I set to work to build one.

The design was evolved around a Gout rotary transformer, type 57, which, when converted as a motor was quite powerful and fast enough for the tiny drills I intended to use. I designed the head as a fixed unit and the table as a movable one, similar to the one I had seen.

Work was begun on the head and two pieces of steel pipe were cut. The one for the head of the pillar was 1 in. bore and $3\frac{3}{4}$ in. long. The other for the main spindle, which runs in ball-bearings, was $1\frac{1}{4}$ in. bore and 4 in. long. A piece of $2\frac{1}{2}$ in. $\times$ $\frac{3}{4}$ in. steel was cut to fit between these two pipes and the whole welded into one unit.

The motor plate, from $\frac{3}{16}$ in. steel plate, was cut later and welded to the column tube.

For the benefit of the reader who has no welding facilities the component parts can be bolted together, as shown in the sketch. It is very necessary to have the parts properly clamped down when welding to ensure that the column tube and the spindle tube have perfect alignment.

The parts for the table supporting arm were next cut, the column tube being cut from the same pipe as the one on the head, but being 2 in. long. A piece of $1\frac{1}{4}$ in. diameter mild-steel $1\frac{1}{2}$ in. long was cut for this unit, to be later drilled for the table spindle to pass through. The mild-steel bar, $1\frac{1}{4}$ in. $\times$ $\frac{3}{8}$ in., was then cut to be welded between the two later, after the head had been machined. This unit can be built up by bolting together, as in the case of the head if the reader so desires.

The baseplate was cut from $\frac{1}{2}$ in. thick steel plate and the tube at the base of the column welded to this. Here again the reader may substitute a turned flanged collar secured to the base by three $\frac{1}{4}$-in. Whitworth bolts.

The next stage was to machine out the tube to fit the column at the head of the machine, which is $1\frac{1}{16}$ in. bore. After this the other tube was bored out clean and then opened out to $1\frac{9}{16}$ in. to take the ball-races at either end, though these were not driven in until a later stage.

The ball-bearings are type LS7 $\frac{5}{8}$-in. bore, $1\frac{9}{16}$ in. outside diameter, $\frac{7}{16}$ in. width, and were purchased from a scrap dealer for 2s. each. Although the reader may not agree that they are the perfect type for this work, they have behaved admirably up to the time of writing.

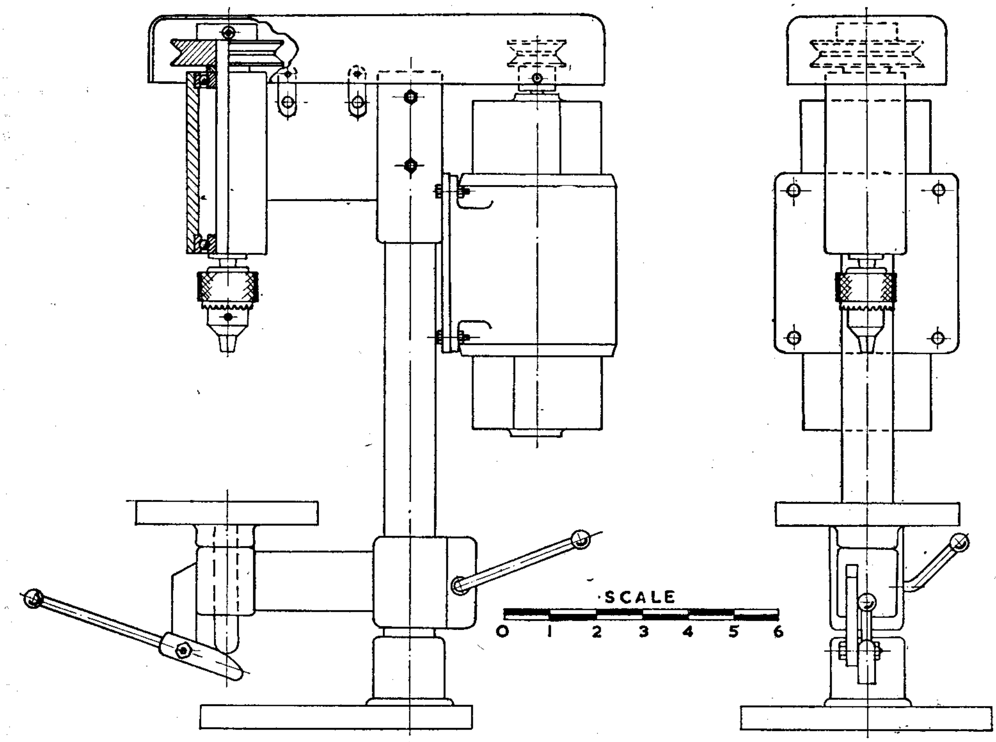
The table supporting arm was next dealt with and the following procedure was adopted. The 1 in. bore tube was welded to the $1\frac{1}{4}$ in. $\times$ $\frac{5}{8}$-in. mild-steel bar and two strips of steel $\frac{5}{8}$ in. $\times$ $\frac{3}{16}$ in. $\times$ 2 in. long were welded $\frac{1}{8}$ in. apart at the rear of tube, opposite to the $1\frac{1}{4}$-in. $\times$ $\frac{5}{8}$-in. steel bar. This partially completed unit was then chucked in the lathe and the tube bored to an easy sliding fit on the column. The space of $\frac{1}{8}$ in. between the two strips was cut through the tube so that the tube could be made to clamp

tightly to the column with the addition of a handle. In place of a handle these two strips were drilled $\frac{5}{16}$ in. and one strip tapped $\frac{3}{8}$-in. Whitworth, the other being opened out to $\frac{3}{8}$ in. and fitted with a $\frac{3}{8}$-in. bolt to clamp the partly finished table supporting arm to the column. It was now time to complete the table fitting, so the following procedure was adopted.

The head unit was clamped to the column and then the table supporting arm, too. A piece level with the table supporting arm and then the 6-in. $\times$ $1\frac{1}{2}$-in. $\times$ $\frac{1}{2}$-in. steel bar was fitted to end of column and $\frac{1}{2}$ in. diameter portion so the whole when clamped down was very rigid for welding.

Before the unit was moved, a piece of steel $\frac{1}{2}$ in. $\times$ $\frac{1}{4}$ in. $2\frac{1}{4}$ in. long was welded to the front of the completed table supporting arm unit, to be drilled later and fitted with the feed handle.

The base was next dealt with and the tube

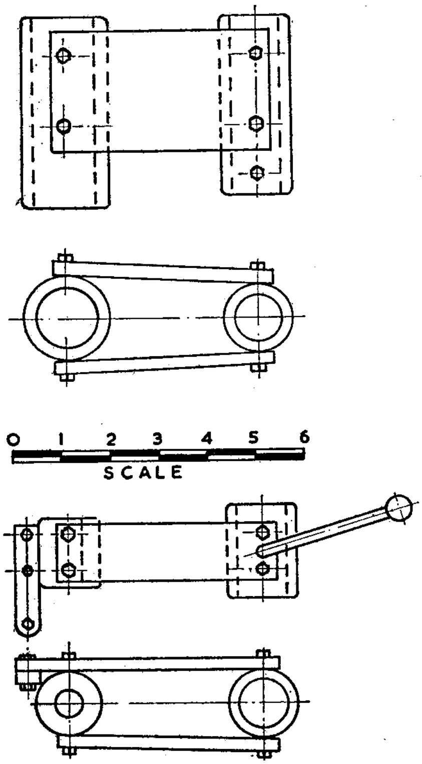



*Two views, showing the general arrangement of the light drilling machine*

of $1\frac{1}{2}$-in. $\times$ $\frac{1}{2}$-in. steel was cut some 6 in. long and two holes drilled in this at 4 in. centres. One hole was $1\frac{1}{16}$ in., a tight fit for the column and the other for $\frac{1}{2}$-in. reamer size. This was then reamed to $\frac{1}{2}$ in. The $1\frac{1}{4}$ in. diameter mild-steel, $1\frac{1}{2}$ in. long, was bored and reamed $\frac{1}{2}$ in. likewise. Next a piece of steel was turned to fit tightly inside the head tube, not yet fitted with ball-bearings. This steel was approximately 7 in. long, the exact length not being important and was turned down to fit the head tube or spindle tube for $3\frac{1}{2}$ in. of its length, the remainder being turned down to fit the $\frac{1}{2}$ in. reamed holes of the $1\frac{1}{4}$ in. diameter steel and the 6-in. $\times$ $1\frac{1}{2}$-in. $\times$ $\frac{1}{2}$-in steel bar. You will see by now that it was intended as a jig for welding the $1\frac{1}{4}$ in. diameter steel to the table supporting arm so as to give perfect alignment of the whole. When this turned bar was fitted to the spindle tube, the $1\frac{1}{4}$ in. diameter steel was fitted over the $\frac{1}{2}$ in. diameter portion to come welded to this was bored out to fit the column and tapped $\frac{5}{16}$-in. Whitworth, so that when the column was fitted inside the tube the stud clamped it tightly in position.

The main spindle was next turned from $\frac{3}{4}$-in. mild-steel. The distance between ball-races was slightly less than $\frac{5}{8}$ in. for easier fitting of the bearings. The pulley end was turned to fit the pulley which is $\frac{9}{16}$-in. bore. The opposite end was turned and the chuck carefully fitted, in my case this being of No. 1 Morse taper. A piece of $2\frac{1}{2}$-in. mild-steel was used for the pulley and this was tapped through the boss to take a $\frac{5}{16}$-in. Whitworth Allen screw to secure it to the shaft. The pulley need not be made of steel, of course, and may be made according to the reader's requirements both in size and material. The motor pulley was turned from $1\frac{1}{4}$-in. mild-steel and the boss of this was tapped to fit a $\frac{1}{4}$ in. Whitworth Allen screw to secure same to the motor shaft.

Various modifications were carried out on the motor, these mainly being the removal of the 6 V end brushes and holders and the enclosing of the commutators at both ends of motor. Cable of the three-wire type is the best for this job and the earth can be fitted to any convenient bolt. This cable was coupled to the motor and after the motor had been secured to the motor-plate by four $\frac{3}{16}$-in. B.S.F. bolts and the belt




fitted, the whole unit was given a run, on the 250 V a.c. mains.

I cannot say the exact speed of the head or chuck, as I do not know the motor speed, but I think the chuck speed is around 5,000 r.p.m. This speed can be altered, of course, by the substitution of different size pulleys and even multiple vee-pulleys would do the trick.

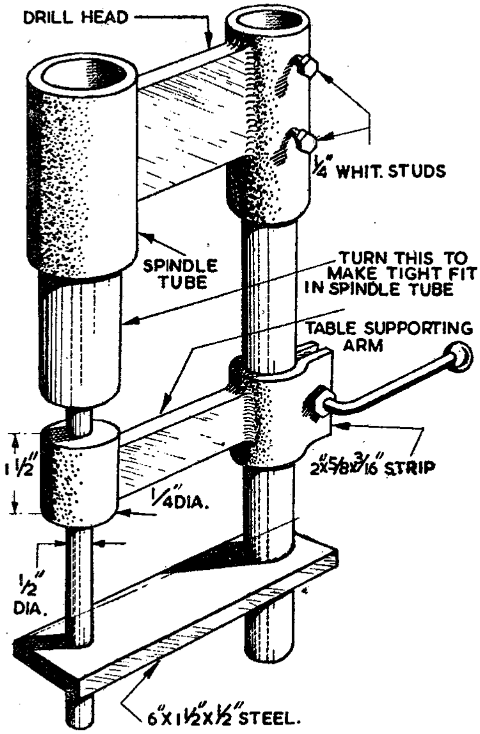
After the head had been run in, I began work on the table. In my case this was turned from a piece of 4 in. diameter mild-steel, but a backplate casting could be used instead. The spindle for the table was made to drive into the table and the remaining portion to slide freely up and down in the $\frac{1}{2}$ in. reamed hole in the end of the table supporting arm.

The feed-handle was turned from $\frac{1}{2}$ in. diameter mild-steel and the end opposite the knob filed flat and drilled for the $\frac{1}{4}$-in. Whitworth bolt as the pivot for this handle.

Adjustment may be necessary to ensure the smooth upward feed of the table by slight pressure on the feed-handle.

The handle for securing the table supporting arm was turned from $\frac{1}{2}$ in. diameter mild-steel, the opposite end to the knob being screwed $\frac{3}{8}$-in. Whitworth, not forgetting to leave a collar in turning to act as the bolt head recently removed. After turning, the handle was bent in the vice, securing the threaded end suitably protected in the vice jaws, the bending being accomplished by means of a length of pipe. Do not bend the handle too far, as it will catch the underside of the motor when raising or lowering the table unit.

To complete the machine I decided to fit a neat cover totally enclosing the belt drive. This was cut from sheet tin and soldered together, the guard being fitted to the drill head by small




*Sketch, showing the method of setting-up for welding table supporting arm*

brackets $\frac{1}{2}$ in. wide and two bolts to secure same to the head.

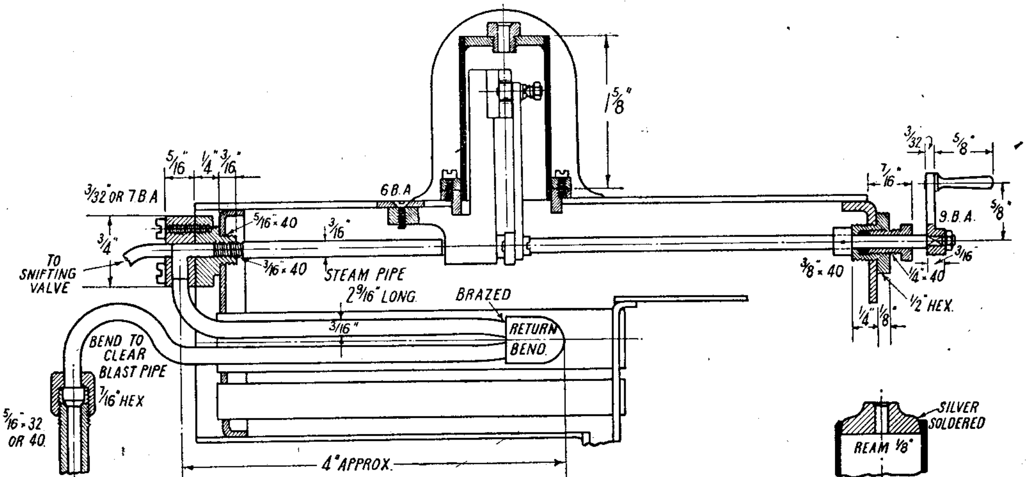
The whole job, after painting, gives a very pleasing appearance and works very efficiently, too.

The reader may alter the design to suit his own requirements and by the use of a more powerful motor of less revs., drill holes up to $\frac{3}{16}$ in., though I would prefer to resort to a heavier drill for this size.

# "L.B.S.C.'s" Beginners' Corner

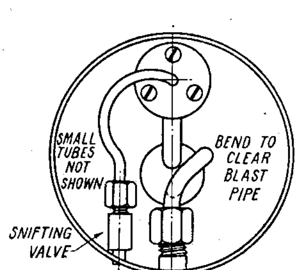
## Regulator for Small-Boilered "Tich"

BEFORE getting down to brass tacks this week, may I apologise to brother beginners for running past a station. After carefully making out the drawings for the regulator and superheater needed for the smaller boiler of our little shunting pug, I suddenly remembered that no details of smokebox door hinges, fastenings, or saddle for the 3-in. boiler had been given. That is what comes of writing ghost stories and what-have-you, for your amusement! However, no harm done, we can easily fit the missing bits before erecting the smokeboxes "for keeps"; the parts illustrated here, would have been next on the list, anyway, so we can go right ahead with the job. As the smaller boiler has a very big dome, we might as well take full advantage of it, and fit a proper regulator; so I have shown one of the simplest type, similar to those used on the Stroudley engines of the L.B. & S.C. Rly. My engines *Grosvenor* and *Jeanie Deans* have exactly the same type, their domes being fairly high, and they give every satisfaction. The whole outfit merely consists of a stand, with a circular portface at the upper end, over which a valve oscillates, opening and closing the ports in a manner somewhat similar to the action of the mechanical lubricator. The valve is operated from a double-armed lever on the regulator-rod, via two con-

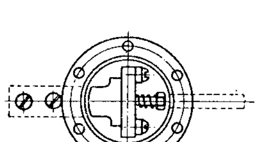



Regulator and superheater for smaller boiler

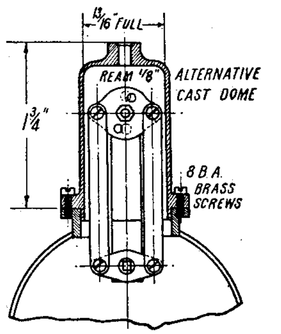
Alternative dome top




Front view of smokebox, showing pipe connections



Plan of regulator

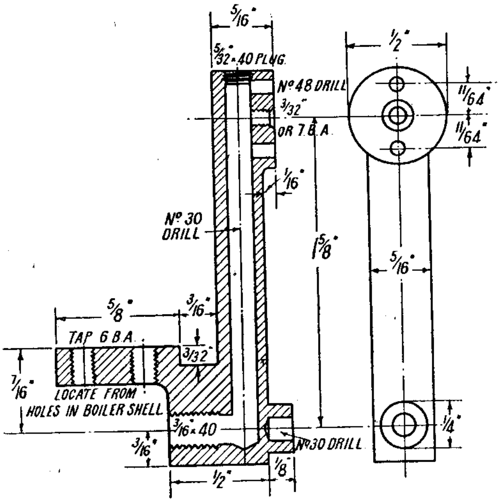



End view of regulator

necting links like weeny coupling-rods. The regulator rod goes out through a gland on the backhead, and is operated by the usual type of single-crank handle.

### Regulator Stand

The stand may be a casting, or built up; our approved advertisers will be able to do the




*Regulator stand*

needful, but the machining and fitting is just the same for either type of stand. To build up, you simply need a piece of $\frac{1}{4}$ in. × $\frac{5}{16}$ in. brass rod, $2\frac{1}{16}$ in. long, at the top of which is filed or milled a $\frac{1}{16}$-in. rebate $\frac{1}{2}$ in. deep like that at the top of the stand for the mechanical pump. Attach a $\frac{1}{8}$-in. slice of $\frac{1}{2}$-in. round brass rod to this, by a $\frac{1}{16}$-in. brass screw. On the same side, at the bottom, similarly attach another small slice of brass rod $\frac{1}{4}$ in. diameter and $\frac{1}{8}$ in. thick. On the opposite side, at the bottom, attach a block of brass sawn and filed up to the shape and size given. Silver-solder all three joints at one heat, using best grade silver-solder, or Easyflo. Pickle, wash off, and clean up, and you have the equivalent of the casting; but the use of a casting saves work

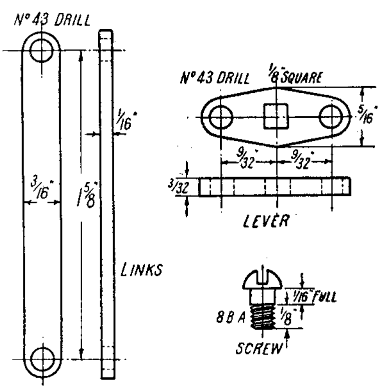
### Drilling the Column

First of all, put a No. 30 drill right down the middle of the column, going to within $\frac{1}{16}$ in. of the bottom. If you haven't a bench drilling machine, don't attempt this job by hand, or it is a million dollars to a pinch of snuff that the drill will wander, and maybe break out at the side. Centre-pop the top, and chuck the column in the four-jaw, with the pop mark running truly; and use the tailstock chuck to hold the drill in the usual way. On a built-up stand, chucking would be easier if the drilling is done before attaching the bits to the column. Tap the upper end 5/32 in. × 40, for about $\frac{1}{8}$ in. or so down; plug it, and solder over the plug. Make a centre-pop in the middle of the port face, and two more at 11/64 in. above and below it. Drill the middle one No. 48, slightly countersink, and tap 3/32 in. or 7 B.A. The other two are also drilled No. 48, going right through into the central hole in the column.

At $\frac{7}{16}$ in. from the top of the step which fits against the inside of the boiler shell when the regulator is erected, drill a 5/32-in. hole as shown, breaking into the hole in the column. Tap this $\frac{3}{16}$ in. × 40 for the steam pipe. Next, drill a No. 30 hole in the little boss, to take the end of the regulator-rod. The easiest way to get this true, is to chuck a bit of $\frac{3}{16}$-in. round rod in three-jaw, and put a few $\frac{3}{16}$-in. × 40 threads on the end, with a die in the tailstock holder. Screw the tapped steampipe hole on to this; the little boss should then run truly, and may be faced off, centred, and drilled as shown. Be careful not to pierce the column too deeply, and break into the central hole; but if you are unlucky, don't worry—you won't be the first, and it is a pretty safe bet you won't be the last! Open out the hole to $\frac{3}{16}$ in., and squeeze in a "blind" bush made from a bit of $\frac{3}{16}$-in. round brass rod. Solder it, to prevent any steam and water going where it shouldn't.

### Take Pains

File out the little recess in the block, to clear the underside of the dome bush, and then true up the port face. This can be done in the manner described for truing up the cylinder port faces, and the stand of the mechanical lubricator. Take pains to have this about right, for a leaky regulator is—well, any full-size driver will give you the exact definition!! Tip—when facing a surface at the end of a component, as in the



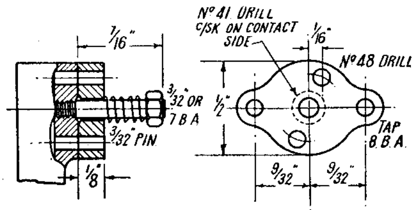

*Actuating parts*

present instance, apply the rubbing pressure *as nearly as possible at the centre of the surface to be faced*; that is, press the port face to the emery-cloth (or other abrasive) by putting your finger on the column, opposite to the trunnion-pin hole. Finish off with pumice-powder and water, or a scrape off your oilstone, on a piece of plate glass, or ground flat steel.

### The Valve

This is cut from a piece of $\frac{1}{8}$-in. brass

plate, to the shape shown in the illustration, which also gives the location of the holes. The two in the ears or lugs are drilled No. 51 and tapped 8 B.A. The steam ports are drilled No. 48, at $\frac{1}{16}$ in. off centre line, and the trunnion pin hole is drilled No. 41, and countersunk on the side that makes contact with the port face. Be careful to face this truly, too! The trunnion




*Regulator valve*

pin itself is a $\frac{9}{16}$-in. length of 3/32-in. round phosphor-bronze—brass will do, at a pinch, but something better is to be preferred—with about 3/32 in. of thread on each end. Screw this into the centre hole in the port face, with a taste of plumbers' jointing on the threads; put a spot of cylinder oil on the rubbing face of the valve, and assemble as shown, using a light spring of bronze or hard brass wire, about 26-gauge, and an ordinary commercial brass nut.

## Lever and Links

The double-armed lever at the bottom of the stand, is filed from 3/32-in. sheet brass. Drill all the holes No. 43, then file the middle one square, with a watchmaker's square file, until a piece of $\frac{1}{8}$-in. square steel will just go through. Give both sides a rub on a fine file, to remove any burrs. The connecting links are only a few minute's work, being merely $1\frac{7}{8}$-in. lengths of $\frac{3}{16}$-in. × $\frac{1}{16}$-in. strip metal (nickel bronze if possible, though anything non-rustable will do as long as it isn't soft) with No. 43 holes drilled at $1\frac{5}{8}$ in. centres, and the ends rounded off. Don't use commercial screws for connecting up; make your own. Chuck a bit of $\frac{3}{16}$-in. round bronze rod in three-jaw, face the end, and turn down a full $\frac{3}{16}$ in. length to a nice fit in the holes in the connecting links. Slip one of the links over the turned part, then screw with an 8-B.A. die in the tailstock holder, until the die barely touches the link. This leaves enough "plain" under the head, for the link to work on. Part off at $\frac{1}{8}$ in. from the shoulder; reverse in chuck, round off the head, and slot it with a fine saw. Connect the links to the lever, but not to the valve; this is done after erection.

## How to Fix the Stand

Drill two No. 34 holes in the boiler shell, one about $\frac{1}{8}$ in. ahead of the dome bush, and the other about $\frac{5}{16}$ in. in front of that; countersink both. Insert regulator stand, block first, through the bush; you'll find it enters quite easily if it is tipped up. Then hold it vertically, with the front edge of the little recess hard up against the dome bush; see illustration of complete assembly. Put the No. 34 drill down the holes in the shell, and make marks on the block, or else scribe circles through the holes. Remove regulator stand, drill the block No. 44 at the marked spots, tap 6 B.A., replace block, and secure with two 6-B.A. brass countersunk screws. Either use a smear of plumbers' jointing under the heads, or sweat them over like stayheads.

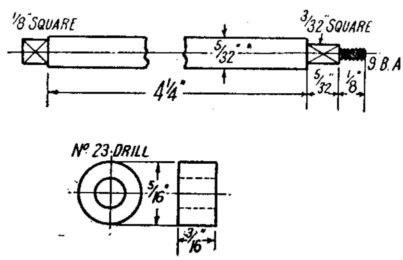
## Steam Pipe and Flange

The steam pipe is a $2\frac{9}{16}$-in. length of $\frac{3}{16}$-in. copper tube not less than 22-gauge, with $\frac{3}{16}$ in. of 40-pitch thread on one end, and $\frac{5}{16}$ in. ditto on the other. Give each end a taste of plumber's jointing, and insert the shorter threaded end, through the hole in the smokebox tubeplate, screwing it home into the tapped hole in the regulator block. If you insert the end of a small round file into the free end of the tube, and use it as you would use a screwdriver, the tube will screw home easily. The file will free itself when turned the other way, leaving the tube in position.

To make the flange, chuck a piece of $\frac{3}{4}$-in. round brass rod in three-jaw. Face the end, centre, and drill down about $\frac{5}{8}$ in. depth with No. 22 or 5/32-in. drill; tap $\frac{3}{16}$ in. × 40. Turn down $\frac{1}{4}$ in. of the outside to $\frac{1}{2}$ in. diameter; further reduce $\frac{3}{16}$ in. length to $\frac{5}{16}$ in. diameter, and screw $\frac{5}{16}$ in. × 40. Part off at a full $\frac{3}{16}$ in. from the shoulder; reverse in chuck, and take a fine skim off the face, to true it up. Put some plumber's jointing on the threads, start it on the end of the steampipe which should just be standing clear of the tubeplate, and screw it right home, until the outside threads engage with the tapped hole in the tubeplate, and the shoulder beds home tightly against it. See complete assembly drawing.

## Operating Gear

The regulator rod is a $4\frac{3}{4}$-in. length of 5/32-in. round bronze rod, phosphor or nickel, it doesn't




*Regulator-rod and collar.*
*(Note :—$\frac{1}{8}$-in. pip at L.H. end accidentally missed out)*

matter which. Turn down $\frac{1}{8}$ in. length to $\frac{1}{8}$ in. diameter, and file the next 3/32 in. square, by method previously described, to a nice fit in the hole in the double-armed lever. At the opposite end, turn down $\frac{1}{8}$ in. length to 5/64 in. diameter, and screw it 9 B.A. File a 3/32-in. square next this, 5/32 in. long. Chuck a piece of $\frac{5}{16}$-in. round brass rod in three-jaw; face, centre, drill

down about $\frac{1}{4}$ in. depth with No. 23 drill, and part off a $\frac{3}{16}$-in. slice.

For the stuffing-box, chuck a piece of $\frac{1}{2}$-in. hexagon brass rod in three-jaw; face the end, centre, and drill down about $\frac{1}{2}$ in. depth with No. 21 drill. Turn down $\frac{1}{4}$ in. of the outside to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. × 40. Part off to leave a head $\frac{1}{8}$ in. thick. Reverse in chuck, and hold in a tapped bush (you should know how to make these by now!) open out to $\frac{5}{16}$ in. depth with 7/32 in. drill, and tap $\frac{1}{4}$ in. × 40. Make a gland from a piece of $\frac{3}{8}$ in. round or hexagon rod, same as described for piston-rod and valve-spindle glands; as we progress, you profit by experience gained in building up the chassis, and I don't have to repeat every operation in full detail.

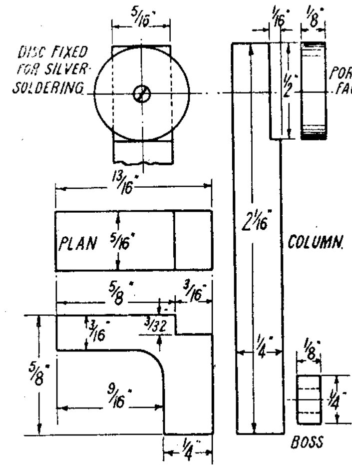
## Steady Boys

Now watch your step over the next bit. Take the two links, with double-armed lever attached, and drop the lever down in place, behind the little boss at the bottom of the stand; then couple the upper ends of the links to the lugs at each side of the valve. Take care the screws don't push the valve off the port face, as they will if they go too far through. If you are unlucky, shorten the screws slightly, and reface the valve in case it has become burred around the screw-holes. Push the collar on to the regulator rod until it is approximately $\frac{3}{4}$ in. from the shoulder where the smaller square starts, at the handle end. Insert the other end through the hole in the backhead, and guide the front end through the hole in the double-armed lever, into the hole in the little boss, the squared part engaging the squared hole in lever. Next, put the stuffing-box on, and screw it right home. When tight up against the backhead, there should be a bare 1/32 in. end play in the regulator rod. If tight, the collar wants moving forward a shade; if loose, shift the collar back. It is a case of trial and error. When you have it right, remove the rod, drill a No. 53 hole through collar and rod, and drive in a piece of $\frac{1}{16}$-in. hard bronze or brass wire. Replace rod, screw home the stuffing-box with a taste of plumber's jointing on the threads, and pack the gland with a few turns of graphited yarn.

The handle is filed up from a bit of $\frac{1}{4}$-in. × 3/32-in. nickel-bronze strip. I have shown a short one for the sake of neatness, but it can be made any length desired. For the boss, chuck a bit of $\frac{1}{4}$-in. round rod, face, centre, drill 3/32 in. or No. 43 for about $\frac{1}{8}$ in. down, and part off a 3/32-in. slice. Silver-solder this to the lower end of the handle, which is filed taper, and drilled $\frac{1}{16}$ in. at the narrow end. The grip is turned from a bit of $\frac{1}{8}$-in. rod, to shape shown, leaving a $\frac{1}{16}$-in. pip on the end. Drive the pip through the narrow end of the handle, and rivet over. Continue drilling the boss with 3/32-in. drill right through the handle; then file the hole square, to fit the end of the rod. Note—put the regulator valve in the "open" position, with the holes in the valve coinciding with the ports; then file the square, so that when placed on the square on the rod, the handle inclines 45 deg. to the left. When the handle is moved to a similar inclination on the right, the ports should be completely covered by the valve. Put the handle on the square, secure it with a 9-B.A. commercial nut, and Bob's your uncle once more!

## Superheater

Heat is the source of power; have your steam plenty hot, and you not only get power, also speed, but you get them with the minimum consumption of fuel and water. The superheater looks after the heat business; and the type shown for *Tich* is a simplified edition of full-size practice. The elements are two pieces of $\frac{3}{16}$-in. copper tube of about 22-gauge; one approximately $3\frac{3}{4}$ in. long, and the other about 2 in. longer. One end of each piece is joined by a "return bend." This is made from a piece of $\frac{1}{2}$-in. × $\frac{1}{4}$-in. copper rod $\frac{5}{8}$ in. long. On one end, make two centre-pops $\frac{1}{4}$ in. apart, and drill them with a No. 14 drill, inclining same towards the centre-




*Parts of built-up regulator stand*

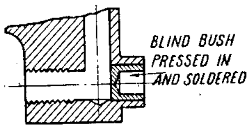
line of the block, so that the holes break into one another about $\frac{3}{16}$ in. inside the block. Keep on drilling until there is free communication between the holes, as shown in the section of the block. Round off the sides and ends as shown; then drive one end of each element into one of the holes, about $\frac{1}{8}$ in. or so, and braze them. Note—silver-soldering is not advisable for this job. Apply some wet flux, then blow up to a good bright red, and apply a piece of soft brass wire, or Sifbronze rod. This will melt and form a fillet around each tube. Soften the other ends whilst on the job, then quench the lot in acid pickle, and wash off in running water. Bend the ends of the tubes as shown; a piece of steel rod pushed in the end, will provide enough leverage to enable this to be done with your fingers.

## The Header

To make this part, chuck a piece of $\frac{3}{4}$-in. round brass rod in three-jaw; face the end, centre, and drill down $\frac{3}{8}$ in. depth with No. 33

drill. Open out to $\frac{1}{4}$ in. depth with No. 22 drill, and part off at $\frac{5}{16}$ in. from the end. Drill a No. 14 hole in the thickness, breaking into the centre hole as shown in the section; also drill three No. 40 holes for the screws. These holes are $\frac{1}{8}$ in. from the edge, and equally spaced. This header is fitted on the bent-up end of the upper element. In the centre hole, fit a piece of $\frac{1}{8}$-in. copper tube approximately $2\frac{1}{2}$ in. long, for the snifting valve.

The swan-necked end of the lower element carries a union nut and cone for coupling up to the vertical member of the cross fitting connecting




*How to correct an unlucky slip*

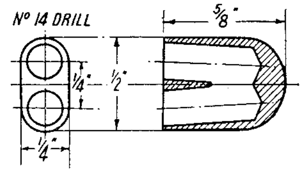
the steam pipes to the cylinders. The nut and cone are made in the same way as those on the oil pipe which connects the mechanical lubricator to the underside of the cross fitting, except that they are larger, the nut being made from $\frac{7}{16}$-in. hexagon rod, drilled No. 10 to clear the steam pipe, and tapped $\frac{5}{16}$ in. $\times$ 32 or 40, to match the screw on which it fits. The cone is made from $\frac{1}{4}$-in. round bronze rod, drilled through with No. 30 drill and opened out with No. 14 drill, to fit on the $\frac{3}{16}$-in. pipe. Warning—don't forget to put the nut on the pipe before fitting the cone; I've seen the nut left off, quite a number of times, and it is easy to be forgetful! Silver-solder the two pipes into the header, and the cone on the swan-neck, at the same heating; also, it would save time if you fit the $\frac{1}{4}$-in. $\times$ 40 union nut and cone on the snifter pipe, and fix that in like manner at the same time. Pickle, clean up, and well wash in running water, letting the water run through the elements, to remove any grits or scale that may have accumulated when the pipes were hot.

## Quick Work

To fit the superheater is a matter of minutes only. Push the element into the flue, and if the header doesn't line up with the flange on the steam pipe, bend the element until it does. Then poke the No. 40 drill through one of the screwholes, make a countersink on the flange, remove the superheater, drill the countersink No. 48 and tap 3/32 in. or 7 B.A. Replace superheater, put a screw in to hold the bits together, then ditto repeato operations on the other two holes. Finally, assemble with a 1/64-in. Hallite or similar jointing gasket between the faces—and don't forget to punch a hole in the middle, for the steam to go through. I recollect sticking on the bank half-way between Sydenham and the Crystal Palace about 5.30 a.m. on a winter's morning when the rails were covered with ice, and the fitter who cleaned the sand pipes and valves had put gaskets between the flange joints without making any holes in them. The heat from his ears should not only have melted the ice, but the rails as well! Yes, I know what you are going to say—but he only put the pipes back about two minutes before we left the depot, and the yard foreman chased us out of it before we had a chance to see if all was O.K.

## Inner Dome

This may be built up, or turned from a casting. To build up, you need a piece of 22- or 20-gauge copper tube $1\frac{3}{4}$ in. long and $\frac{15}{16}$ in. outside diameter. If not available, either bend it up from sheet copper, or use a piece of 1-in. $\times$ 3/32-in. turned down at one end to fit the dome bush. The upper end is plugged by a disc of 3/32-in. sheet copper with a $\frac{1}{4}$-in. $\times$ 40 tapped hole in the middle; or a piece of 1-in. brass rod can be chucked in three-jaw, and a cover turned to fit as shown, with the hole for the safety-valve in it. Turn about $\frac{3}{8}$ in. length to a tight fit in




*Block return bend for superheater element*

the tube, and part off at $\frac{5}{16}$ in. from the end. Hold $\frac{1}{8}$ in. of this in the chuck, and set to run truly. Centre, drill through with No. 34 drill, ream $\frac{1}{8}$ in., and slightly countersink, the end with a centre-drill; then round off the top, similar to the shape of the cast dome shown, and press into the end of the tube.

Now take the disc you used to cover the dome hole when testing; chuck in three-jaw, centre, drill to $\frac{3}{4}$ in. in about three stages (if you try to put a $\frac{3}{4}$-in. drill through right away, it will chatter badly) and bore out to fit tightly on the outside of the tube. Press it on at $\frac{1}{8}$ in. from the bottom, and silver-solder both top and bottom at the one heat. Pickle, wash, and clean up. Put it temporarily in place with a couple of screws, to protect the regulator whilst putting on the rest of the blobs and gadgets. We will fit the safety-valve later.

A cast dome should be chucked in three-jaw with the flange outward. Turn the spigot to an easy fit in the dome bush, face the flange, and turn to diameter; then bore the inside to $\frac{13}{16}$ in. full diameter, same as boring cylinders. Mount on a mandrel, a bit of hard wood turned to fit, does fine; hold the mandrel in the chuck, and turn the outside to the shape shown. Face the boss on the end, centre, drill No. 34, ream $\frac{1}{8}$ in. and countersink slightly for the safety-valve. Bore the testing disc as mentioned above, until it becomes a ring which will slip on the spigot; then use the holes in it as a jig to drill the flange, running the drill through the holes in the ring, and carrying on through the flange. Clamp them tightly together with a toolmaker's cramp, so that the holes coincide exactly, and will thus match up with the holes in the dome bush.

# *An Experimental Steam Turbine Plant

## A chronicle of many endeavours and trials in the quest for high r.p.m.

by D. H. Chaddock

FOLLOWING Mr. Elkin, the convergent part of the nozzle was made to the arc of a circle by means of a shaped " D " bit and the divergent part by a straight 1 in 10 taper. This gave a divergent nozzle cone length of 3/10 in., much more than is customary in model work but necessary on account of the high working pressure and the considerable expansion, 500 to 15 lb. per sq. in. in a single stage. In passing, it may be mentioned that a 20 thou. hole is the size of a No. 76 drill and just about the size that " L.B.S.C." recommends for the steam cones of his weeny-weeny injectors. And yet it was hoped that two nozzles of this size would not only feed the plant with water but produce useful power as well.

### The Nozzle and Filter Assembly

Fig. 4 shows the final assembly of the two nozzles, the steam filter and the main steam pipe union. Some liberties have been taken in this drawing to get all the parts in the same sectional plane as will be apparent by comparison with the photographs, but it is otherwise true to scale.

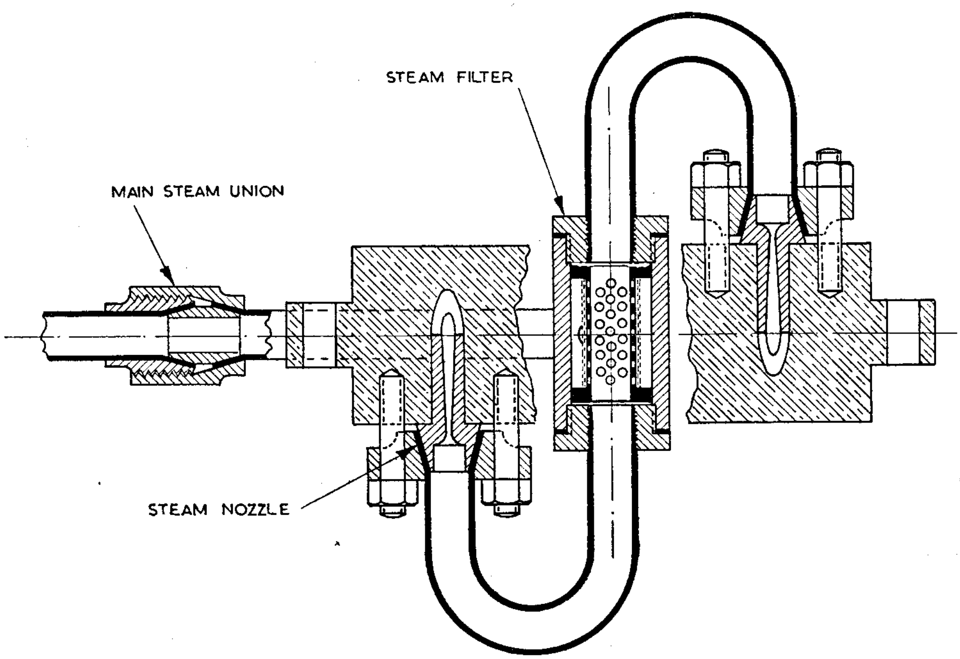



*Fig. 4. The nozzle and steam filter assembly for a flash steam turbine*

It was intended to make the nozzles of stainless steel but one or two experiments with a No. 76 drill showed that this was a very bad idea indeed. A change was made to $3\frac{1}{2}$ per cent. nickel high-tensile steel without trouble in the drilling and forming stages of the convergent side but disaster ensued when the long slender " D " bit was used to form the 3/10 in. long taper only 20 thou. diameter at the throat. Finally, by drilling most of the metal away by twist drills of decreasing diameter sunk to progressively greater depths so that the " D " bit only had to convert a series of steps into a smooth surface, the job was done.

The outside of the inlet end of the nozzles is formed as a 30 deg. included angle cone and with the end of the steam pipe, which is flared out to an equal angle, forms a solderless and

*Continued from page 969, " M.E.," December 21, 1950, Vol. 103.

screwless union, a bridle, also of $3\frac{1}{2}$ per cent. nickel steel, holding all secure.

The steam filter was not originally fitted but although the boiler was continually blown out with steam and compressed air, dirt and scale continued to come over and to block the tiny nozzles, and that in spite of the pressure of steam behind.

The filter has two layers of 200 mesh copper gauze wrapped round a perforated gunmetal bobbin and secured in place with bronze wire. The body and screwed end caps with soft copper sealing washers, are high-tensile steel and the steam pipes are screwed into them with fine pitch threads as well as being brazed. The steam inlet is tangential to the filter drum so there is probably some cyclone separation effect before the steam passes through the fine gauze and the swirling action helps to keep it (the gauze) clean.

This gadget has never given any trouble and has cut down, but not entirely eliminated, stoppages due to nozzle blockage.

The main steam pipe union is another example of solderless and screwless fitting. The cone angles are again 30 deg. included and the union nuts and olive are made of high-tensile steel. It has never failed to come up steamtight, even when red-hot and with 500 lb. of steam pressure within it, nor to break on the all too frequent occasions when the plant has had to be taken down for repairs.

**Back Numbers Forward!**

The boiler and blowlamp were designed in 1913 and are replicas of the ones used by Mr. H. H. Groves in his very successful flash steam aeroplane. What particularly struck me about this design and why I chose it in preference to the dozens which have appeared in THE MODEL ENGINEER was that not only was it extremely light, the boiler, casing, blowlamp and tanks only weighed 1 lb., but it appeared to be extremely efficient. A full description of the complete plant, from the pen of Mr. H. H. Groves, appears in THE MODEL ENGINEER for May 8th, 1913, and subsequent issues and in the course of which Mr. Groves mentions evaporating 3 oz. of water per minute for a consumption of $\frac{3}{4}$ oz. of benzoline. As he also speaks of the steam pipe becoming red-hot and his $\frac{7}{8}$ in. bore by $\frac{1}{2}$ in. stroke twin-cylinder single-acting steam engine drove a 16 in. diameter airscrew at sufficient speed to give a 2 lb. static thrust, there is not much doubt about the boiler efficiency.

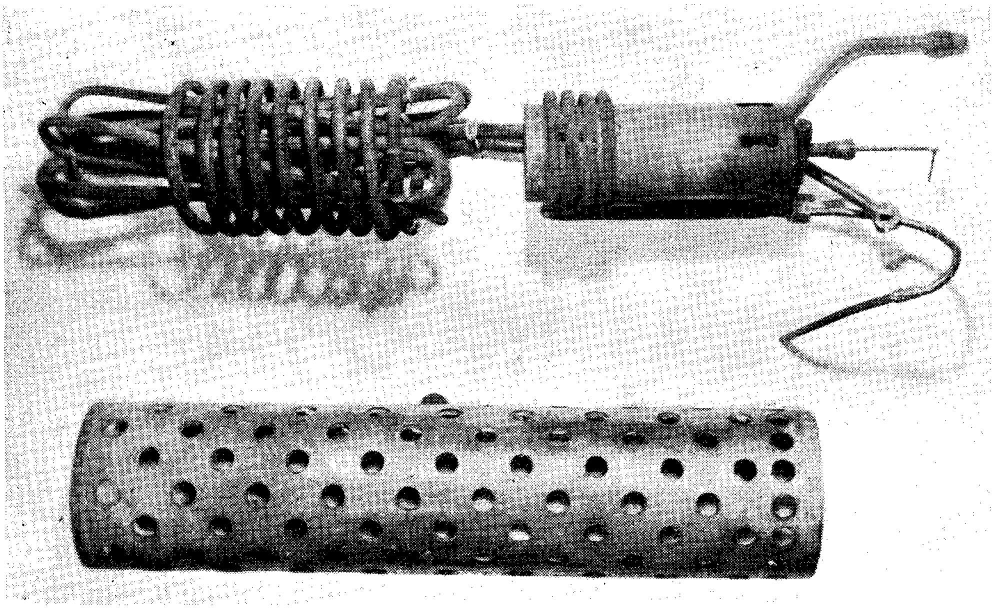


*Fig. 5. 37 years old. A replica of the flash steam boiler and blowlamp used by Mr. H.H. Groves in an early steam-driven aeroplane*

For the benefit of readers who have not access to these early volumes and in honour of a pioneer, the photograph, Fig. 5, shows the writer's replica parts. The lamp was made exactly as Mr. Groves described it; it functioned perfectly the first time it was lit and has never been altered since. It has an adjustable nipple, a thing out of fashion these days, which not only keeps the nozzle clean but also really effectively regulates the size of the flame—a very useful feature in the early stages when the plant was being tuned up.

The boiler coil, also shown in the photograph, contains rather more than the minimum of 7 ft. of $\frac{3}{16}$ in. o.d. by 20-gauge steel tubing recommended by Mr. Groves. In point of fact it contains 10 ft., repeat 10 ft., but I am not sure that the extra length has brought a commensurate advantage.

The most noticeable difference between this boiler and modern ones is that most of the

tubing, or at least what there is of it, is in longitudinal zig-zags which, by a cunning disposition, receive the full blast of the $1\frac{1}{4}$ in. diameter blowlamp along their entire length, thus breaking up the flame without impeding the products of combustion. It has always mystified me why modern flash steam boiler designers, after squeezing in the most powerful blowlamps they can manage, then arrange the boiler coils in such a way that each coil shields the next and seem terrified of putting any tubing in the direct blast of the lamp.

The Groves boiler does not suffer from this defect. If one is not nippy with the starting pump the zig-zags rapidly approach a yellow welding heat and flecks of molten scale begin to emerge from the end of the casing! Of course, a reciprocating engine with pistons and valves could never live under these conditions but a turbine—well, that is a further part of this story.

The casing, which forms the third item in the photograph, is also deceptive in its simple efficiency. Mr. Groves made his of tin plate only $4\frac{1}{2}$ thou. thick, lined with $\frac{1}{16}$-in. asbestos. I could not get, at the time, such thin material so used ordinary " one cross " tinplate about 14 thou. thick.

The asbestos lining close to the coils I have found a great advantage. Its use is not to insulate the heat; the outside is blued at once, but the inside gives an incandescent glow wherever the flame touches it. Anyone who has tried brazing a heavy job with and without a backing of coke and asbestos cubes will appreciate the value of reflected heat close to the work.

The perforations which extend over the whole surface of the casing give perfect ventilation, air being drawn in or exhaust products expelled just as if the flame were burning in open air. Furthermore, readers familiar with aerodynamics and the pitotstatic tube will recognise the fact that this casing with its hemispherical cap is, in fact, the static element of the tube and that the internal pressure, when the whole assembly is in a relative wind is the true atmospheric pressure.

For the reasons mentioned, my equipment did not come out quite as light as Mr. Groves. The combined weight of coils, casing and lamp is the same as his which included the tankage for fuel and water. However, I fully believe it will evaporate as much water as many more modern plants weighing two or three times as much, so all credit to a successful pioneer.

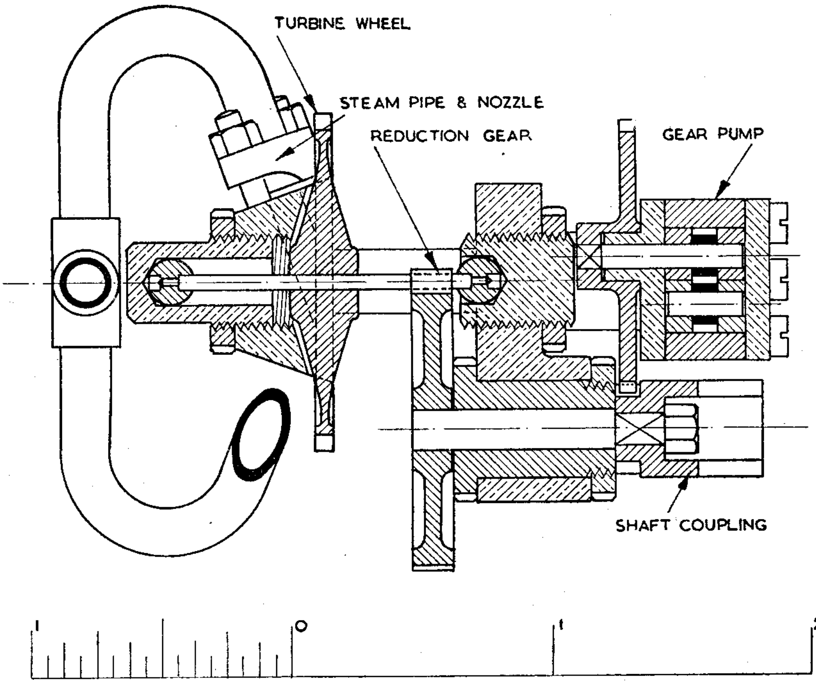



*Fig. 6. The turbine as first constructed with a flexible shaft and epicycloidal gears*

### The First Turbine, No. 1, Mark I

At this stage something really ought to be said about the first turbine experiments because the reader, having waded through the description of the making of the wheel, the nozzles and the steam-raising part, is probably as anxious as I was to know whether the wheels would go round.

The line drawing, Fig. 6, and the photograph, Fig. 7, show the plant much as it was in its first incarnation. Of the two the line drawing is the more accurate as the steam filter was not then

fitted and sundry holes and gadgets are the result of subsequent experiments. The little rectangular box with six cheese-headed screws is a gear feed pump and really belongs to a much later, and sadder, story, so it can be ignored for the present.

The mainshaft on which the turbine wheel is mounted came ready-made ; it is, in fact, the arbor of a piece of high-grade clockwork, complete with 10-leaf pinion and beautifully polished pivots, 20 thou. diameter by 50 thou. long each end. 20 thou. holes seemed to haunt me at this stage because the blowlamp nipple was also drilled this size, but I put two more in the centre of $\frac{3}{16}$-in. diameter bronze balls to act as self-aligning plain bearing. Because the 20 thou. pivots seemed on the small side, even in those days, I took the precaution of sinking holes only just larger than the shaft into the balls to act as " catcher " bearings—just in case.

The meshing gear with the 10-leaf pinion was the usual clock variety, thin sheet brass, and as it did not, in any case, have the number of teeth I wanted I decided to cut another one the full $\frac{3}{16}$ in. width of pinion to get extra strength. A bronze blank was silver-soldered on to a high-tensile steel shaft and the whole lot turned up true. The original pinion and wheel turned out to be a rather funny pitch, 108.6 d.p., so it was probably metric, cycloided form, but with a lot of patience a tiny form tool only 15 thou. wide on the pitch line was shaped up. This was then used to plane the teeth into the blank by putting it on its side and racking the saddle back and forth. Racking is the word to describe that operation ; there were 120 teeth to cut and each required many passes before the tiny tool could be fed to full depth. Even then there was trouble because the tough phosphor-bronze objected to this operation and the teeth began to lean over sideways under the pressure of the cut. I was not proud of that wheel when it was finished but the urge to get cracking was so great that I decided to use it as it was.

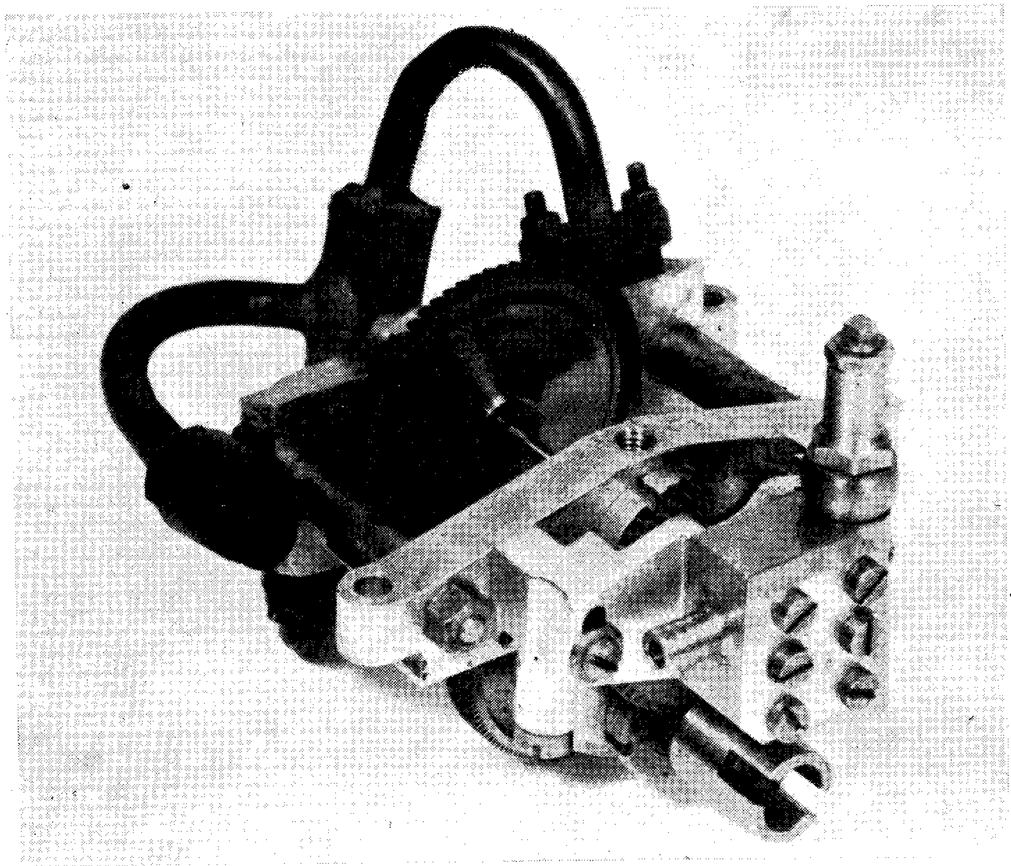


*Fig. 7. A reconstructed photograph of the turbine in its first form. In the foreground an experimental gear-type feed pump*

The rest of the construction needs no special comment ; it is mainly hacked out of lumps of duralumin, except the various methods of adjustment. It will be noted that both wheel bearings are carried in screwed housings with lock-nuts. This enables the end shake to be adjusted

and the turbine wheel to be brought to minimum running clearance to the nozzles, a point which Mr. Elkin found most important.

The main shaft with its 120-tooth wheel one end, and eventual propeller shaft coupling the other, is carried in a single phosphor-bronze bearing which is bored, deliberately be it noted, 1/32 in. eccentric. This has proved to be a most valuable feature and is in use to the present day for, by slightly rotating the bearing in its housing and then locking it into position, the gears can be brought perfectly into mesh.

So far we have got everything except the feed pump and as I had not got one either, an "L.B.S.C." tender hand pump was rigged up, the idea being that if things got too hectic I could ease off the pumping a bit. I had also read that a flash steam plant can be regulated by the size of the flame and, determined to proceed in easy stages, I rigged up the whole plant with a bunsen burner as the heating element.

However, lots of heating and pumping only produced showers of hot water and clouds of "kettle steam" and an obstinate refusal of the turbine wheel to revolve. Determined to make the wheel revolve that night, or rather morning, since it was then long past midnight, the proper blowlamp was put in place and very gingerly lit up. The result was immediate and spectacular. The boiler, which was already half full of water from the previous experiments, immediately began to generate real hot high-pressure superheated invisible steam and without any pumping at all the turbine began to accelerate wildly out of control. For a few seconds there was a rising crescendo scream, during which I began to look for places to take cover, then white sparks flew from the rim of the wheel and all was silence. I went to bed a happy man knowing that the first of what would undoubtedly be a long series of smash-ups had already taken place.

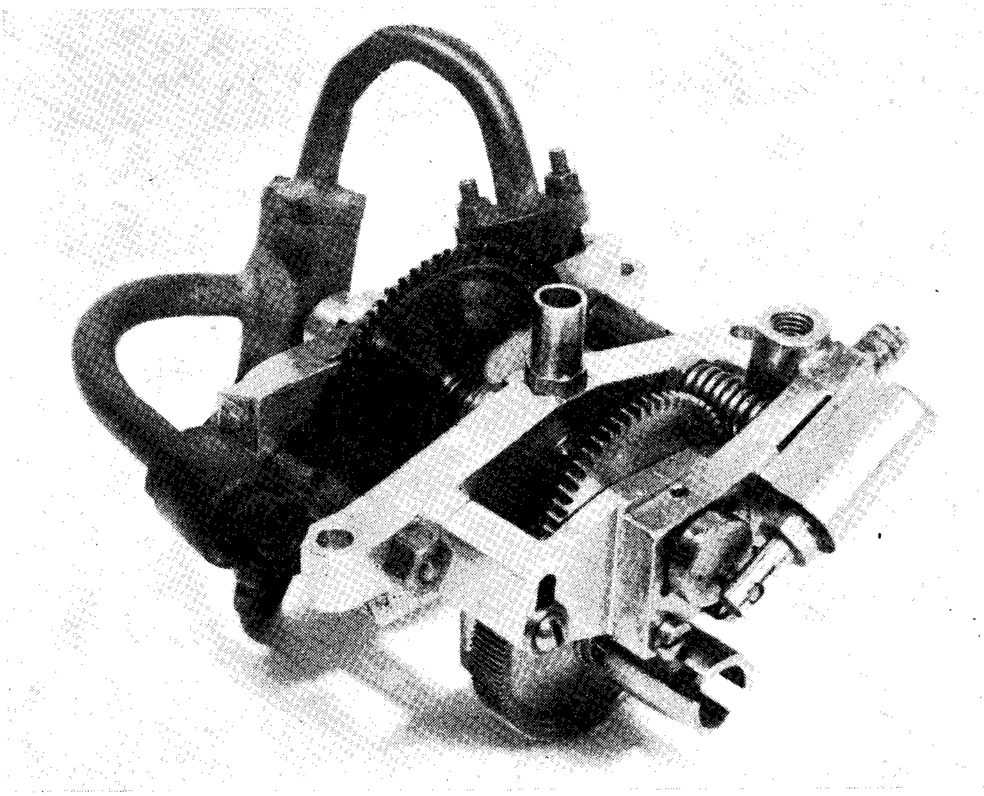


*Fig. 8. The turbine as rebuilt with the wheel mounted on a overhung shaft, and fitted with an oscillating cylinder feed pump*

## The Morning After the Night Before

A post-mortem examination revealed that all ten leaves on the pinion had disappeared without trace. Both the 20 thou. pivots were snapped off short in their journals but, thanks to the "catcher"-bearings, the wheel had not come completely adrift. It had, however, had sufficient freedom to rub the nickel steel nozzle bridles and in coming to rest had milled neat nicks into them—hence the sparks. Thanks, however, to the superlative material of which it was made it was itself quite undamaged and here I sighed with great relief. A rebuild was ahead but the most important parts, the wheel and nozzles were undamaged.

**The Mark II Turbine**

The photograph, Fig. 8, shows the turbine as it was rebuilt. Instead of mounting the wheel in the centre of a long and relatively flexible shaft with bearings each end as is normal de Laval practice, I decided to come one stage nearer gas turbine practice by mounting the wheel its own feed pump and gearing, nor means of estimating the speed at which it was running, beyond the noise.

However, the members of the societies were kind and said that it was the most promising turbine that they had seen, but they did not say what it promised. I knew!

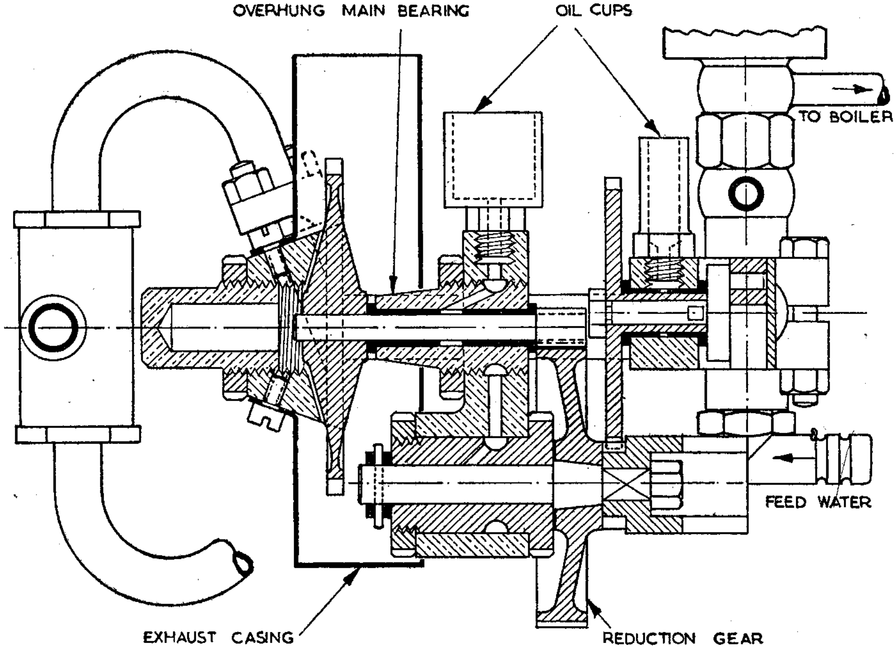



*Fig. 9. The turbine in its final form with overhung shaft, involute gears, exhaust casing and twin plunger feed pumps*

overhung on one end of a relatively stiff shaft. By turning the main bearing frame around most of the existing parts could be used, the general layout, but not the detail being as shown in Fig. 9. Another clock arbor was found, with 12 leaves in the pinion this time, but the pivots were broken off, all too easy that, and the centre portion, some $\frac{1}{16}$ in. diameter and $\frac{5}{8}$ in. long, used as a bearing.

A new bronze gear wheel blank was turned up but the form tool instead of being used for planing was fitted up and used as a flycutter. This produced excellent teeth with no tendency to malformation and much less effort since machinery was now cutting the metal instead of hand power.

By this time too a sufficiently reliable feed pump had been evolved to be worth coupling to the engine and is shown in the photograph. It will probably be recognised by "live steamers" but not for the purpose for which it is being used. In this form the plant made several runs and was demonstrated to some members of the Orpington society in March, 1949, and again at an S.M.E.E. stationary engine meeting in April of the same year. On both occasions the blowlamp was kept well throttled down and a ready hand on the water by-pass to check any untoward rise of pressure, since there was no load on the turbine, beyond

**"Pons Asinorum"**

In every account of flash steam plant development that I have read comes sooner or later, and generally sooner, a record of feed pump troubles. How nice it would be I thought if, having an engine with no pistons or valves, only pure rotary motion, one could have a feed pump of the same sort. Nothing could be simpler.

**A Gear Wheel Feed Pump**

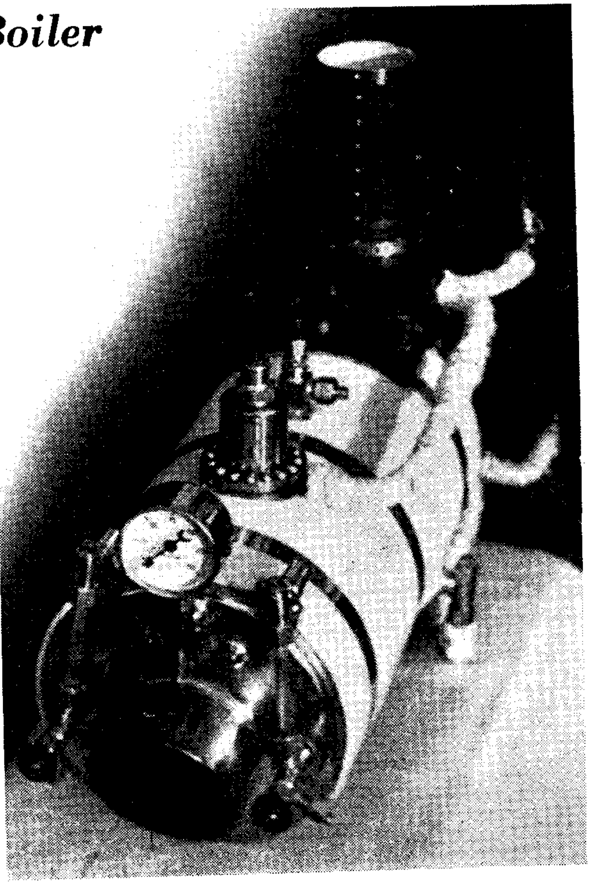
During the war many readers probably came across Service hydraulic equipment with gear wheel pumps; in fact, a paper has been written about them for the Institution of Mechanical Engineers. The odd thing about them is that although they look for all the world like the humble suds pump, we all know they work at amazing pressures, hundreds or even thousands of pounds per sq. in.

What a lovely thing for a boiler feed pump. No valves to leak, no glands to pack, no rams to wear, only two little gear wheels whizzing round in steady rotation. The fact that such pumps invariably work with a special hydraulic mineral oil, are precision made and hardened and ground in all parts seemed to be no reason to me for not "having a go."

*(To be continued)*

# A Model Marine Boiler

## by R. L. Allen



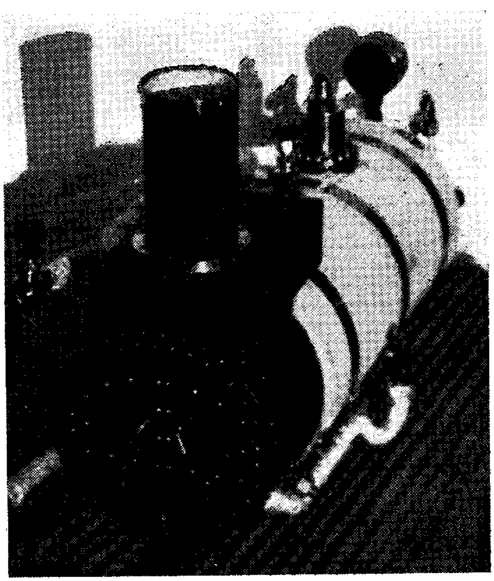
READERS have asked from time to time for descriptions of model marine boilers and plants in general, so I hope that this article may be of some small use to those interested in model power boats of the steam-driven class.

The boiler was made by me some time ago for the purpose of supplying enough steam to drive a 6-ft. model liner, the engine of which was a $\frac{3}{4}$ in. × $1\frac{1}{4}$ in. × $\frac{7}{8}$ in. compound, non-condensing type, a small engine to work the boiler feed pump and a third engine to drive a bilge pump. It did this job easily with some to spare.

This is how it was constructed. A piece of 5 in. diameter copper tube by 16-gauge was used for the barrel, this being 10 in. in length; a 12 in. length of $2\frac{1}{2}$ in. diameter by 18-gauge made the flue; $\frac{3}{8}$ in. diameter by 20-gauge tube was used for the flue water-tubes and the end plates were made from $\frac{1}{8}$ in. thick copper plate over a steel former $\frac{1}{2}$ in. thick.

The flue-tube was made corrugated as an idea for strength, and I believe, it added somewhat to the steaming qualities, as the boiler steamed fast for its type.

The corrugations were formed by making a former in hardwood (oak).



First it was turned to a nice fit in the flue-tube, then returned to the lathe and the corrugations turned at $\frac{3}{4}$ in. centres. It was then removed and sawn lengthways into six pieces. A seventh piece was cut square to provide a wedge to be driven down the centre of the former when placed in the tube. Next, two hinged clips were made, with a radius turned on the inside and lugs on the sides opposite the hinges and fitted with a strong bolt; they were then slipped over the flue-tube with the former in place and tightly clamped up, thus forming the corrugations as they were moved down the tube, which was kept well annealed.

The water-tubes were then silver-soldered into the flue at $\frac{3}{4}$ in. centres, there being 14 in number. Next, the back end plate was Sifbronzed into the barrel, the front end was brazed to the flue, and the parts put for the final brazing, the ferrules for the fittings and steam dome being silver-soldered in last.

I water-tested the boiler to 200 lb. per sq. in., and it showed no signs of distress anywhere. The fittings were then mounted and a steam test was made to 100 lb. per sq. in. It would easily

(*Continued on page 25*)

# Jigs for the Model Engineer

by S. F. Weston

FOR any repetition work at the bench, it pays to make jigs. This is really very interesting work, and although it occupies time, that time is well spent, and if the jigs are robustly and carefully made, ensures the finished articles being all alike—in the long run saving time.

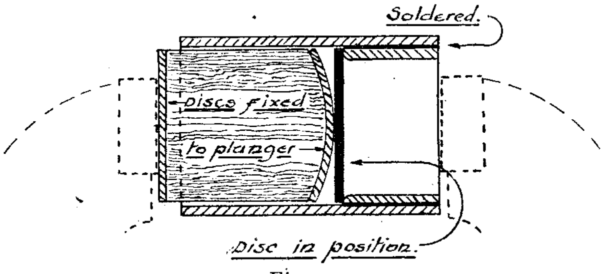



*Fig.* 1

The jigs made should be kept, as it will often be found that they are applicable to other work with some small adjustment. Three examples are given below :—

(1)—It was necessary to dish a large number of brass discs $1\frac{1}{4}$ in. in diameter by $\frac{1}{16}$ in. thick. It was essential that they should all be curved to a pre-determined extent, and to effect this the jig shown in Fig. 1 was found satisfactory.

A 2 in. length of stout brass tubing $1\frac{1}{4}$ in. clearing internal diameter and a $\frac{3}{4}$ in. length of $1\frac{1}{4}$ in. outside diameter tubing were soldered together, the top edge of the smaller tube having been previously rounded off as shown. A wooden plunger, about 2 in. long, with one end shaped to the curve required was made to fit the larger tube.

A disc was thoroughly annealed, placed in the jig and dished by applying pressure in the vice. This disc was attached to the curved end of the wooden plunger by means of wood screws well countersunk. A second disc was then bent and whilst in position the plain end of the plunger was carefully marked off from the end of the larger tube and squared off $\frac{1}{16}$ in. short of this mark, and a flat disc fitted by countersunk screws.

The batch of discs to be dished were all thoroughly annealed, placed in the jig, and by screwing up the vice until the jaws just touched the tube ends the whole quantity were curved, one at a time, to exactly the same extent.

(2)—It was required to mark off centre-lines on each opposite side of a number of lengths of $\frac{3}{4}$ in. outside diameter tubing.

A strip of wood, about 6 in. long was planed up square and exactly $\frac{3}{4}$ in. wide. Two pieces of brass were carefully screwed on, each projecting $\frac{3}{8}$ in. above the flat surface of the wood, and at one end a stirrup-piece was attached. This was fitted with a set-screw to grip the tube to prevent same turning whilst marking-off. A line scribed, as shown, on the tube, each side, gives accurate centre-lines (see Fig. 2).

(3)—A number of brass strips $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. $\times$ 3 in. long required to be bent to shape, all having to be exactly alike.

The flat strip was first cut to lengths exactly 3 in. long in the simple gauge shown above in Fig. 3, the cuts being made with a metal-piercing saw. Two strips were then bent by hand to the required shape ; these, when checked for shape, were fitted to two pieces of $\frac{1}{4}$ in. thick hard wood.

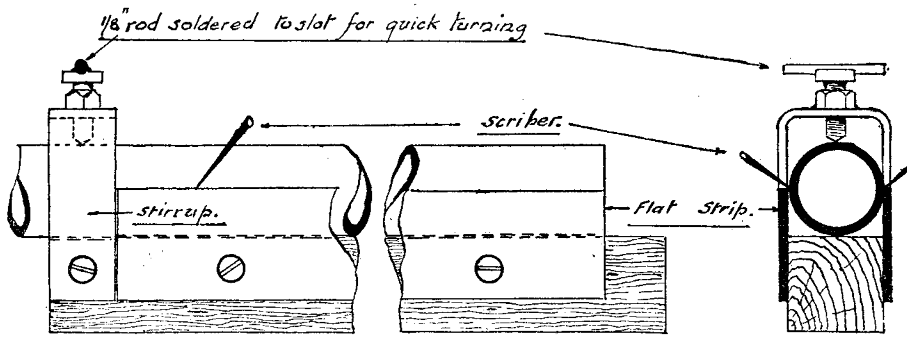



*Fig.* 2

One of the pieces was fixed securely to a base-block by means of glue and wood screws. Two hard wood guide-pieces were then fitted to the base-block by the same means. The second piece fitted with the brass strip, was arranged to slide between the two guides, easily, but without

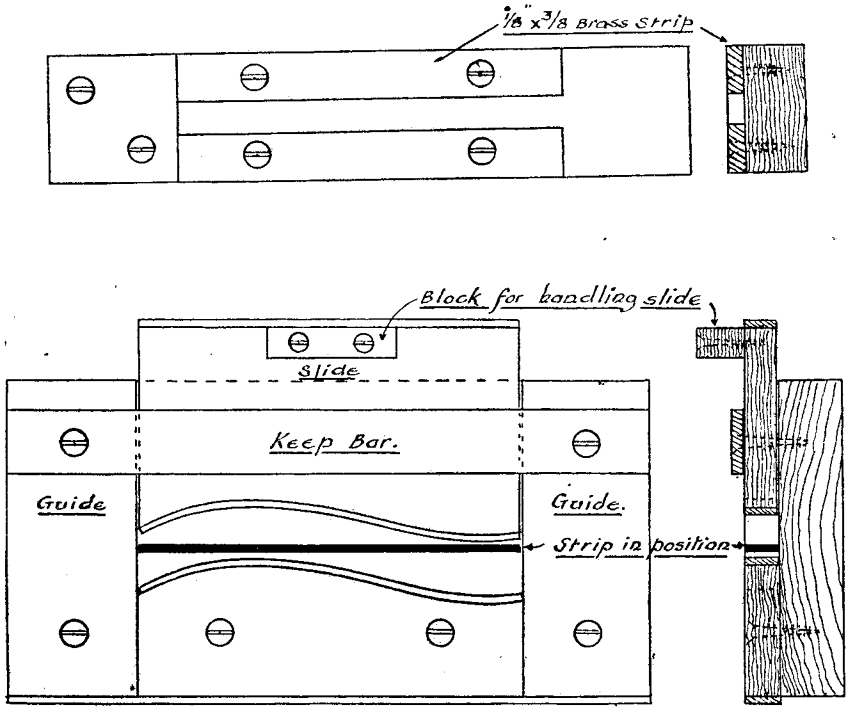



*Fig.* 3

slogger. A keep-bar was attached to keep the slide in position. The slide and the base block were shod with brass strips for contact with the jaws of the vice.

The strips to be shaped were annealed, placed in the jig as shown, and by screwing up in the vice, the whole quantity were bent to exactly the same curves.

These three examples may give some idea of the usefulness of jigs, but it is not possible to give more exact details, because each job, naturally, calls for some special detail peculiar to it; but with a little thought, ingenuity and consideration in design, most repetition jobs can be helped by the use of jigs.

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# A Model Marine Boiler

(*Continued from page* 23)

have taken more, but as the working pressure was to be 80-100 lb. this was considered enough and the safety-valve was set at that. The fittings consist of two water gauges, $\frac{1}{4}$ in. bore glass, two clack valves, steam dome with safety-valve mounted on top, two steam wheel valves for the outlets, a pressure gauge reading 150 lb., also the superheater and feed water coils placed in the smokebox. The firing is by paraffin blowlamp.

Readers may perhaps wonder why the separate engine for the feed pump, when it is usually driven through gearing from the main engine shaft. The answer is this; the model was intended to steam on any water, including salt water, and for this a tank was fitted in the hull to carry fresh water when this took place, but the chief object in mind was, should the boat at any time get stuck by weed fouling the propeller, no harm would result, as the boiler would still be fed and would only stop steaming when the source of heat went out.

I, and a number of readers, no doubt, have seen many boats stuck as mentioned, and the outcome has been disastrous, usually before any attempt at rescue can be made. The boiler has run dry and collapsed, and sometimes the boat is burned to water level and becomes a total loss; a tragedy such as this should not be allowed to happen to a model boat of this size and value!

# An Adjustable Pin-Wrench for Circular Nuts

## by W. M. Halliday

CIRCULAR locking-nuts of the kind shown at *A* and *B*, Fig. 1, are very extensively used in machine construction and for general engineering purposes; in the manipulation of such members, it is possible that some difficulty might be encountered.

The type of nut at (*A*) may be provided with four, six or eight shallow, square notches '*a*' in its rim. These will be disposed equidistantly apart, and extended fully across the width of the component for greater convenience when machining.

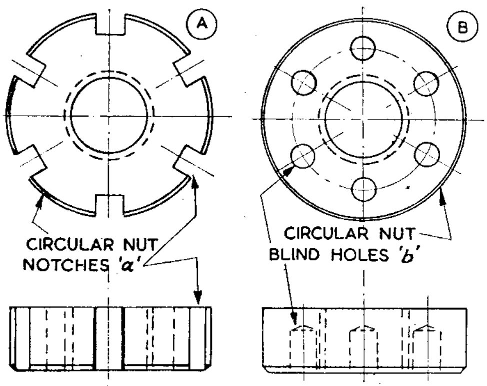



*Fig.* 1

Type (*B*) nut consists of a plain circular ring having any convenient number of blind holes '*b*' drilled into one side. These holes will be located at equal spacings around a selected pitch circle, so that each pair of holes will be diametrically opposed. The two diagrams, (*A*) and (*B*) Fig. 2, illustrate two common forms of peg or pin wrenches which are conveniently employed in conjunction with such locking-nuts.

For the notched kind of nut, a peg wrench of the type shown at (*A*), Fig. 2, will be used. This simply consists of a piece of rectangular section cast-steel bar *B* having one end bent over semi-circular in shape. The inside diameter of this bent portion *must conform closely* to the outside diameter of the lock-nut *A* if effective gripping and retention of the nut is to be obtained.

The extreme end of the curved portion of the wrench is bent inwardly, or otherwise machined, to provide the projecting lip, which passes into any of the notches around the rim of the nut *A* in the manner shown. Nut *A* is depicted in light broken lines.

By pulling upon the straight portion of the handle in the direction indicated by the arrow, the nut *A* will be powerfully trapped between the lip and the bearing point *D* at the opposite side of the curved portion.

The type of pin-wrench (*B*), Fig. 2, is employed with lock-nuts having a series of drilled holes in one side face.

The form of wrench *D* is bent substantially in the same manner as with the previous example, but instead of a single projecting lip, it is provided with two cylindrical pins as at *E*. These project from one side of the wrench, and must be accurately disposed so as to engage freely within any pair of opposed holes in the nut.

Numerous practical objections and limitations will be associated with wrenches of this kind. In the first place, the inside of the curved portion must be approximately the same diameter as the lock-nut to be handled.

With wrench (*A*), Fig. 2, the size of the projecting lip will largely determine the applicability of the tool. The dimensions of this will have to be smaller than the width of the notches in the nut. Moreover, if the lock-nut is situated in an enclosed space, it may not always be possible to mount the wrench on the periphery of the nut as shown in the sketch. In use, some wear or

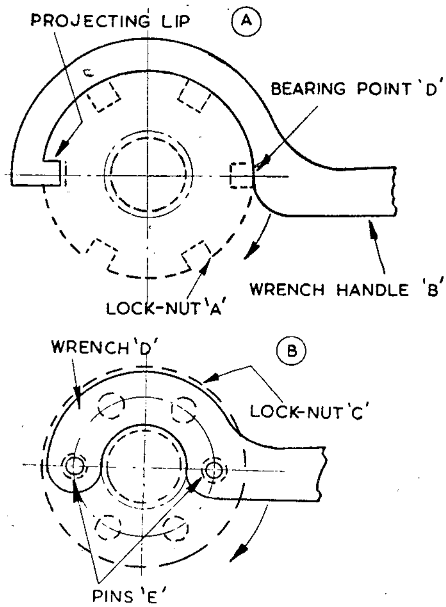



*Fig.* 2

distortion of the lip may occur, this giving rise to slippage when locking a nut on its shaft. Such slippage may result in the nut being disfigured and damaged, or an insufficient locking pressure being applied.

The type of pin wrench (*B*), Fig. 2, is even more limited in application, because it can only be used on nuts where the holes are spaced at exactly the same diametrical distance apart as the fixed pins *E* on the wrench. This means that for almost every size of lock-nut, a different spanner will have to be used, having the fixed pins *E* spaced at the required distance apart.

## An Adjustable Pin-wrench

The diagrams, Fig. 3, depict an adjustable and almost universal type of pin-wrench which may be successfully employed for overcoming the aforementioned limitations surrounding the use of wrenches of the kind shown at Fig. 2. This adjustable wrench consists of a length of rectangular section cast-steel, radiused each end, and smoothly finished at the sides to form the wrench handle *A*. This is left perfectly straight, as shown.

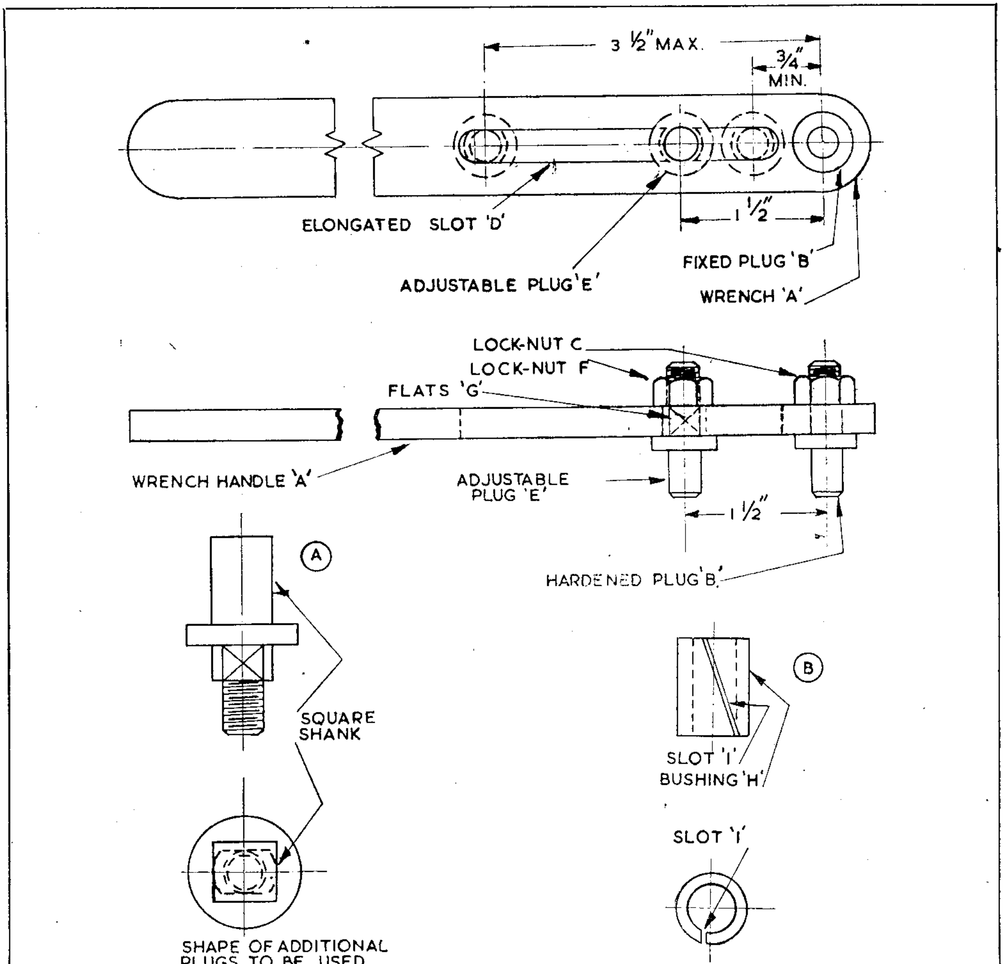



*Fig.* 3

Near one end, the shouldered plug *B* is permanently fixed into a drilled and reamed hole through the handle. This plug may be secured by means of an ordinary hexagon lock-nut *C* screwed on to an extended threaded portion of its shank.

Running centrally down the width of the handle *A*, for a certain distance, is the elongated parallel-sided slot *D*. Fitted so as to slide freely therein is the adjustable plug *E* substantially the same shape and size as plug *B*. The cylindrical

shank portion fitting within slot *D* should be provided with two opposed flats as at *G* to prevent this member turning radially in the elongated slot. A hexagon lock-nut *F*, the same size as nut *C*, is employed to retain this plug in any position within the elongated slot.

The upper view, in front elevation, shows the magnitude of adjustment possible in respect of the sliding plug *E*. This is shown set at a centre distance of $1\frac{1}{2}$ in. away from the fixed plug *B*. The light broken lines indicate the minimum and maximum settings possible. By advancing plug *E* and locating it as close as possible to the fixed plug *B*, their centre distance will be reduced to $\frac{3}{4}$ in. With plug *E* situated at the extreme opposite end of the elongated slot *D*, however, this centre distance will be increased to $3\frac{1}{2}$ in. In practice, this will mean that the wrench may be readily adjusted to suit lock-nuts having notches or holes spaced at any intermediate centre distances between those limits.

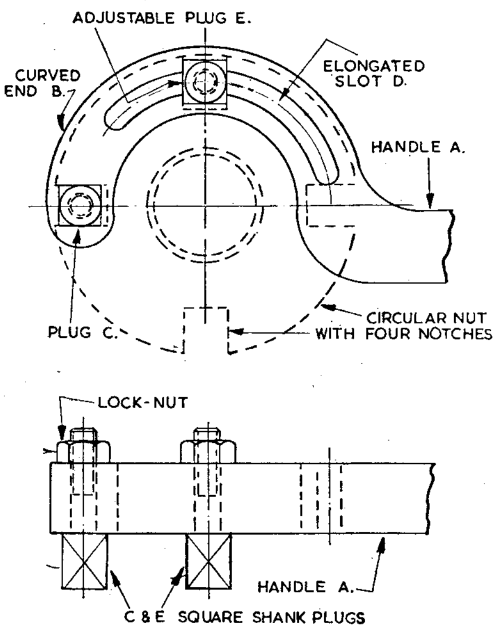



*Fig.* 4

Where the adjustable spanner has to be employed with lock-nuts having drilled holes in one side face, the projecting shanks of the pins *B* and *E* will be cylindrical, as shown in the upper diagrams.

If the spanner is to be used with notched type lock-nuts, it will be necessary to employ plugs *B* and *E* having square shanks after the fashion depicted in the enlarged drawing (*A*) in the lower left-hand corner, Fig. 3. One such plug will have a cylindrical portion for fitting into the drilled hole in the end of the wrench, whilst the other plug will have a shank, below the shoulder, having two opposed flats for engaging in the elongated slot *D*. The size of the squared portion of these plugs will be determined by the width of notches provided in the lock-nut.

Still further to increase the versatility and usefulness of this adjustable type pin-wrench, bushings of the kind shown at (*B*), Fig. 3, may be successfully employed. These bushings *H* should be made in hardened and tempered cast-steel. The bore of the bushing should be machined about 0.003 in. to 0.005 in. *less* than the diameter of the cylindrical portion of plug *E*. The outside diameter will be made slightly less than the diameter of holes in the nut. To impart the required spring, a narrow saw cut, *I*, is formed across one side wall, this being disposed at an angle to the longitudinal axis of the piece as shown. Slitting one side of the bushing in this manner will enable the part to be tightly pressed on to the plug shank and to be retained thereon by the light pressure spring imparted by the slit.

Any number of adaptor bushings of this kind may be made up to suit various sizes of locking rings. Their manufacture will prove far less tedious and expensive than that of making up a full set of separate pin-wrenches of the conventional type.

### Use in Restricted Locations

To achieve greater convenience and easier accessibility of the wrench to restricted locations, the straight handle portion may be cranked or inclined at any convenient distance or angle, starting such cranking from a point beyond the end of the elongated slot *D*. By making the engaging portion of the plugs *B* and *E* of ample length it will be possible to apply and operate the wrench quite successfully, even though the shaft may project for a considerable amount beyond the side of the circular locking-nut.

In very many instances interference with the projecting shaft may be avoided by adjusting the plug *E* close to the fixed member, so that it will not be necessary to engage in diametrically opposed notches round the periphery of the locking-nut.

### A Modified Pin-wrench

In cases where the shaft is of very large diameter relative to the outside diameter of the ring, and when it has to project a considerable amount beyond the side of the member, it might prove more advantageous to employ the modified form of pin-wrench depicted in the diagram, Fig. 4. With this form of tool the handle *A* is curved at one end as shown at *B*. The degree of curvature is not vitally important, provided the inside radius is slightly larger than the maximum shaft diameter to be dealt with. At the extreme end of the curved portion is the fixed plug *C*. An elongated slot *D* is provided centrally upon the curved portion, being truly radial with part *B*. An adjustable engaging plug *E* is fitted into this slot, being locked therein by an ordinary hexagon nut, as with the previous example.

Whilst this type of wrench will allow the extended portion of a shaft to pass with clearance through the opening formed by the curved end, it will not be necessary to situate the plug *E* for engaging into diametrically opposite notches.

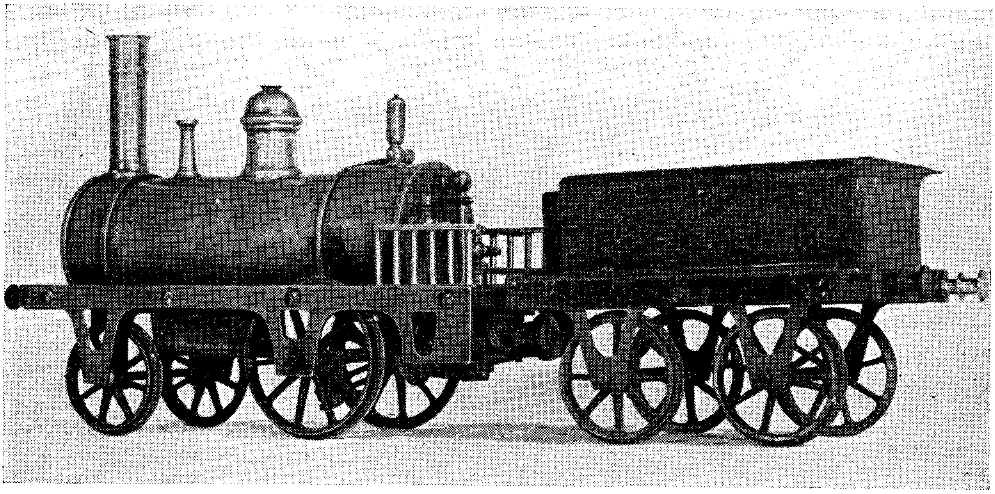
# A Traction Engine Goes Canvassing

THE photograph reproduced below shows a traction engine engaged in quite unconventional sort of work—for a traction engine; in fact, the rakish angle at which she is wearing her spark-arrester would seem to suggest that she is thoroughly entering into the prevailing hilarity of the occasion! For it was a "rag" organised by the students of Loughborough College, and we think that most readers will know what that means. However, it would seem to have been quite an orderly rag, judging by the account sent us by Mr. L. A. Egglestone a member of the Loughborough Model and Experimental Engineering Club, who writes :—

"The photograph shows a Ransomes engine with forty years' work to its credit. It has stood idle for some years, but a number of enthusiastic students prevailed upon the owner to lend it to them. After inspection by the insurance company, a reduction of boiler blow-off pressure to about 20 lb. p.s.i., and last, but not least, plenty of hard work by the students cleaning up, she was ready for the road, proudly taking her position at the head of the fine procession of half a mile of topical and humorous tableaux. For about two hours, she puffed cheerfully round the town and, I hope, loosened the pockets of the crowd in aid of the local charities for which the Carnival is raised annually.

The flagman and bell can be plainly seen, but possibly the double spud-pans and the holes for attaching the spuds will be more interesting to readers of 'Ours.'"

We are indebted to the *Loughborough Herald and Monitor* for permission to reproduce the photograph.



# An Old Model Locomotive

## by A. J. C. R. Goodall

THE two photographs herewith show an old model steam locomotive which has been in the possession of my family for a great number of years and which I thought might be of interest to readers of THE MODEL ENGINEER.

My first recollection of this engine—more than 45 years ago—is that it was, even then, very much of a wreck. It had no chimney, the foot-plate railings and the "innards" of the safety-valve were missing as were also the front buffer-beam and buffers. Moreover the wheels revolved with an extremely bad grace because their axles were bent. Attached to a piece of string, however, it did its heroic best to keep us children amused.

As time went on we ceased to be interested in this pastime. We grew up, married, started our own homes and the old engine disappeared and was forgotten. Then, quite recently my mother rediscovered the old veteran in some hidden corner of her house and sent it to me to remind me of bygone days with the suggestion that I might be able to "put it right."

To do this would have meant scrapping the boiler, because I feel sure it would be unsafe under steam after all the years that have elapsed since it was made. As I wanted to retain as much of the original material as possible, some other means of "making the wheels go round" had to be found. This has been done by removing the original exhaust pipe—which has been carefully labelled and preserved—and making a new connection to the steam-block in its place so that a supply of compressed air can be fed into the cylinders. By putting the steam-cock into the reverse position the engine can, by this method, be made to run forward.

Whether the model ever worked satisfactorily, even when new, is a moot point. The plain pot boiler $2\frac{3}{8}$ in. in diameter and about $6\frac{1}{2}$ in. long must have been hard put to it to supply enough steam for two double acting oscillating cylinders $\frac{7}{16}$ in. diameter and $1\frac{1}{4}$ in. stroke especially as the latter were not provided with glands for the piston-rods. These work through guides in the front cylinder covers which now leak like sieves and were probably never a very good fit.

As far as external appearance is concerned, the model would seem to have been designed on the lines of Stephenson's "Planet," and, in replacing the missing parts, I have been guided by an outline sketch I have of that engine. It would be interesting to know to what extent these restorations depart from the original appearance of the model. Any authentic information which could be given to me in this connection will be thankfully received and faithfully applied.

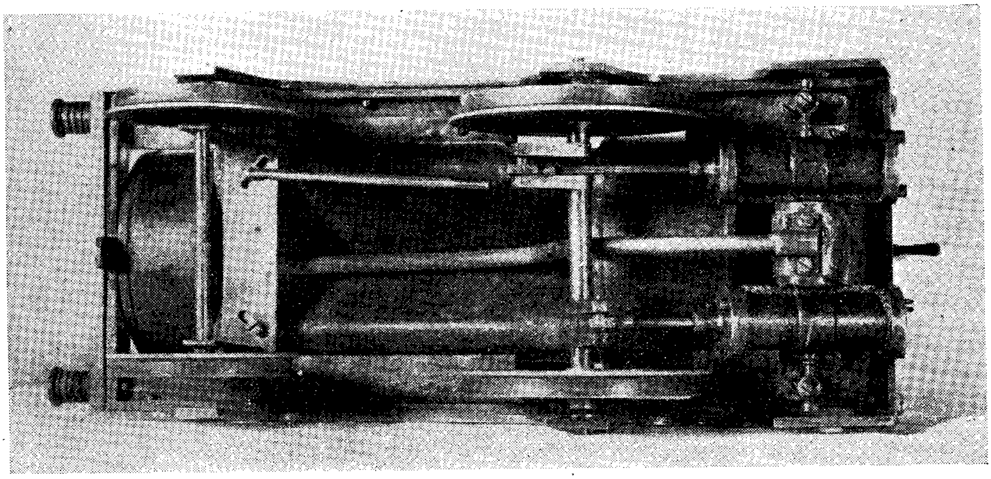
There are several interesting points in the construction of the engine which are worthy of mention and are not without their amusing aspect. The flanges of the driving-wheels, for instance, are milled to provide a better grip on the "oil-cloth" with which the floor would probably have been covered in those days. The leading wheels are carried by a separate frame which can be partially rotated and then locked by two screws thus causing the engine to run on a circular course. This arrangement can be seen quite clearly in one of the photographs. One final point concerns the exhaust which was carefully superheated by passing the pipe through the flames of the spirit lamp. This was presumably a precaution taken to prevent the dropping of pools of oil and water on the floor with the consequent parental rumpus.

In order to preserve this old model I am considering providing it with a glass case and

mounting it so that the driving-wheels are just clear of the rails. In this way it will be possible to show it working under compressed air as occasion arises without the necessity of removing it from the case.

In conclusion may I refer to what is, I think, a pressing problem in connection with old models in general? It is the provision of some permanent sanctuary dedicated to their preservation. Those of us who own them know their value and interest, but in the years to come they may well pass into the hands of those not so instructed and be lost or destroyed. This, surely, is something to be avoided at all costs.

I am indebted to Mr. A. C. Angell, of the Croydon S.M.E. for the photographs.



*What she looks like underneath*

# "The Lathe That Won't Turn True"

J. H. Davis writes: "The article under the above heading in THE MODEL ENGINEER for October 5th, 1950, on page 538, raises several important and interesting points which must at times be very puzzling to amateurs and others who are beginners at the trade.

The heading does not seem to be wholly correct, as the meaning of not turning true in the machine shop usually refers to the work being out of round. However, as the trouble seems to be in producing work which is parallel, I would suggest that the first essential is to make quite sure the lathe is level crossways. It does not matter so much lengthways, the idea being to remove any twist in the bed. Use a good level on two parallels placed across the bed, one at the headstock end and one at the tailstock end; if the bed is out, pack under each leg as required. If parallels cannot be used or are not available, place level on bearing-ways of cross-slide or on the boring table and traverse the carriage first to the headstock end of the bed and then to the tailstock end and note where it is out, and adjust accordingly.

The advice to start with ordinary cast-steel lathe tools can be recommended because the manipulation of cast-steel is well within the capabilities of amateurs. It can be annealed for filing or otherwise working to the shape desired and does not require too much heat for hardening and tempering. These tools can also be readily ground on ordinary emery wheels. I can quite understand the reason for some amateurs investing in the best in the way of cutting tools, but would strongly suggest in most cases they are only throwing money away in buying tungsten carbide tipped tools. These tools require an entirely different technique in use to high speed or cast-steel tools. Ample power must be available so the tool does not stall in the cut, otherwise the tip will be chipped and this means a lot of grinding to put the tool in good condition again. Do not drag the tool back past stationary work; if the tool setting does not want to be altered, bring the tool back while the work is revolving at turning speed. Do not stop the lathe while the tool is cutting or is in contact with the work, and always turn dry. Another point against tungsten carbide tools for the amateur is that at least three wheels are necessary for sharpening. One ordinary wheel to grind away surplus shank metal under the tip, one special medium wheel to grind the tip and one lapping wheel."

# Novices' Corner

## Cotter Locks

AN example of a cotter lock which will be familiar to many readers is the method by which a bicycle pedal crank is attached to its spindle. Doubtless, many will have had occasion at one time or another to tighten the cotter which is the means by which the two parts are secured.

kept tight, for once wear has begun to take place and movement between the parts can occur, the lock will break down.

From the example given above, it will be seen that, in the main, cotters are used to secure levers to shafts.

In Fig. 1B a form of lock suitable for light

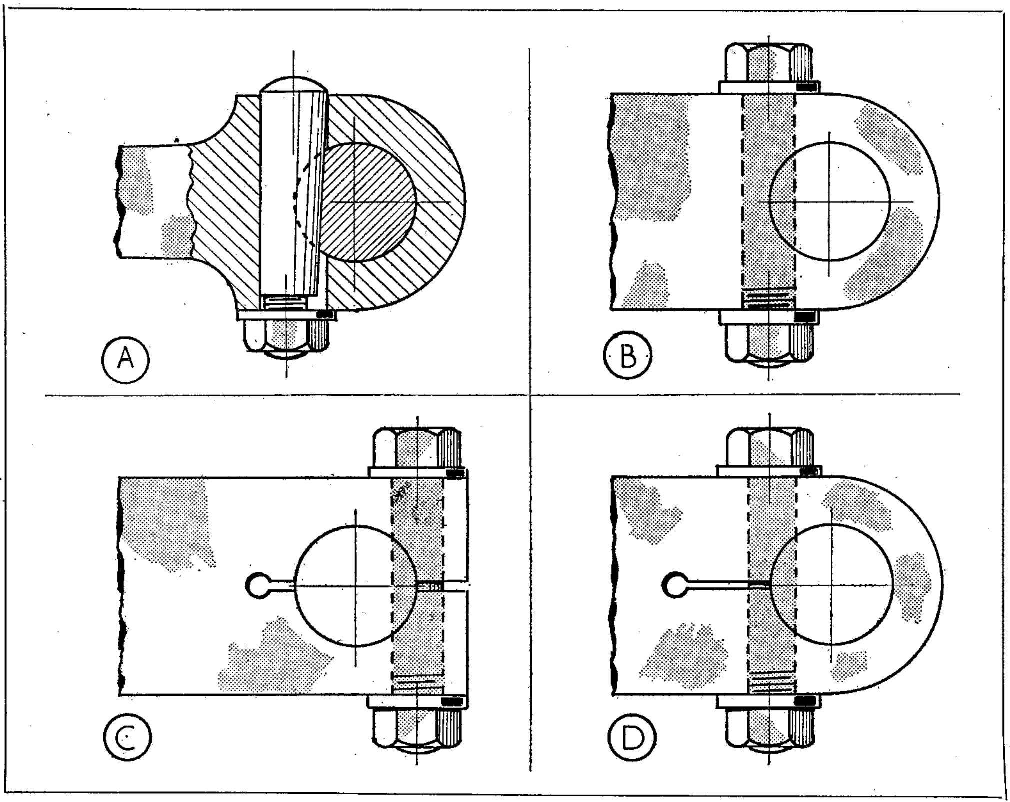



*Fig. 1. Some forms of cotter lock*

As will be seen from the illustration, Fig. 1A, the cotter, which is usually some $\frac{3}{8}$ in. in diameter, has a flat surface machined upon it. This surface is set at an angle to the axis of the cotter, and engages with a corresponding flat surface formed on the spindle itself. If the cotter is drawn inwards by means of the nut shown in the illustration a wedging action between the parts will result, and the cycle crank and its spindle will be firmly locked together.

If a lock of this type is to be satisfactory, the parts must be accurately made and the cotter must be properly fitted. The joint must also be

duty only is illustrated. Although all the parts are made an accurate fit in the first instance, there is nothing in the design which will allow the joint to be tightened to remove any slackness which may develop. It will be seen that the cotter takes the form of a close-fitting bolt which engages the shaft and the lever, and is located in a hole drilled and reamed in both components simultaneously after they have been assembled together. The shaft should, in the first place, be made a firm fit in the lever, while the bolt itself is, preferably, made a driving fit. Under normal conditions of service, this will prevent movement taking place between the parts.

Unidirectional loading, unless excessive, will not disturb the fitting, but continued reversals of movement are likely to do so. Therefore, this method of securing parts should not be adopted when the movement is continuously changing direction. It is better to use an arrangement which allows for any slackness to be taken up, and is fitted to withstand loading in either direction. This method is shown in Fig. 1C, where,

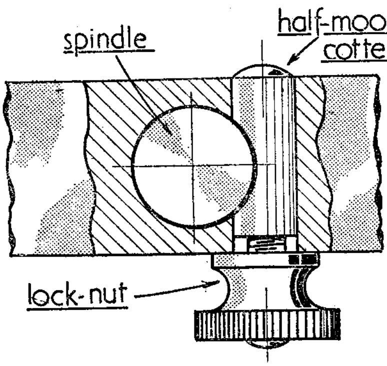



*Fig. 2. Cotter lock to allow spindle to slide*

it will be seen, the lever has been slotted so that the bolt can be used to contract the lever upon the shaft or spindle.

The amount of contraction is, however, limited. This is on account of the binding action produced by the close-fitting bolt in its hole. The major components must, therefore, be themselves well fitting in the first place, to lessen the degree of contraction needed to grip the parts together.

In the illustration the locking-bolt is shown on the outer end of the lever. But the cotter bolt may equally well be positioned on the inside, in the manner shown in Fig. 1D. This location, moreover, allows the end of the lever to be rounded if desired. The amount of contraction afforded by this arrangement is, perhaps, rather less than that provided by the design previously illustrated in Fig. 1C. Therefore, once again the fitting of all the components must be good in order to ensure that the maximum frictional hold is extracted from the device.

In all designs of cotter lock which embody a parallel and well-fitting bolt, it is advisable to use cotters made from high-tensile steel. By doing so, troubles due to elongation of the bolt will be eliminated.

## Forms of Lock Which Allow Adjustment of the Parts

In Figs 2 and 3 are shown two arrangements which allow the cotter not only to prevent movement, but to permit it to take place when required.

This form of lock is used in circumstances when rapidity of adjustment is essential. It is found, for example, in some types of scribing gauge and in the locks sometimes fitted to lathe tailstock barrels.

When it is necessary to lock and unlock sliding members, the cotters used differ from those previously considered, in that they have a half-moon concave surface machined upon them as illustrated in Fig. 2. They are drawn in to close engagement with the sliding part either by a knurled finger-nut, as shown, or by means of an ordinary hexagon nut to which a spanner may be applied. This method of securing two parts may also be employed to arrest radial movement, but should not be subjected to severe torsional stresses. We, ourselves, have used this method to secure small carburettors on the induction manifolds of small petrol engines, an application which proved completely successful and also provided a perfectly gas-tight joint.

Once again emphasis must be laid on the necessity of both the machining and the fitting to be accurate, otherwise the results will be unsatisfactory.

## No Side Thrust

A variation of this form of lock is illustrated in Fig. 3 where the method used for locking the tailstock barrel of the Myford M.L.7 lathe is illustrated. It will be obvious that any form of constraint which tends to deflect the tailstock barrel sideways is useless and would be bad design. Thus, a half-moon cotter, if applied in the manner shown in Fig. 2, would be quite unsuitable, as the barrel would be pulled to one side as soon as the locking lever was operated.

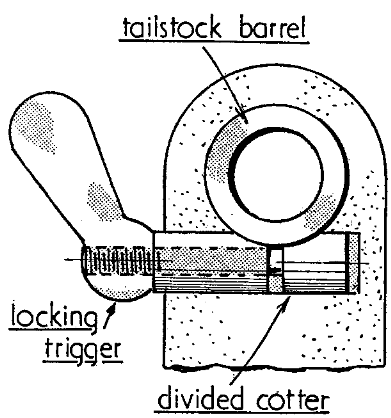



*Fig. 3. Method of locking the Myford M.L.7 tailstock barrel*

On the other hand, if the cotter is divided, and is free to float, as will be seen in the illustration, no side thrust whatever can be imposed on the barrel. In practice, one-half of the cotter is extended to form a stud upon which the locking lever is mounted. The other half, which is bored to fit over the stud, then acts as a thrust bush for the lever, which compresses both parts together and engages them with the tailstock barrel. This locking device is housed in a blind-ended hole formed in the tailstock casting at right-angles to the axis of the barrel.

# *Queries and Replies*

*Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by stamped, addressed envelope, and addressed: "Queries Dept." THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.*

*Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.*

*More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibley by a short explanatory article in an early issue. In some cases the letters may be published, inviting the assistance of other readers.*

*Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.*

*Only one general subject can be dealt with in a single query; bur subdivision of details into not more than five separate questions is permissable. In no case can purely hypothetical queries, such as examination questions, be considered within the scope of this service.*

### No. 9887.—Dynamo Speed
### C.R.W. (Ferring)

**Q.**—I have a 12 V old car dynamo, apparently about 80 to 100 W, at 1,800 revs. The field magnet is about 6 in. × 5¼ in. × 4¼ in., 2-pole with commutating poles. Would you kindly let me know if I could increase the output by rewinding the field coils with finer wire, say to about 150 W. I want to use it with a small 24-V d.c. motor. Would there be any objection to using 38-s.w.g. double-silk covered for it?

**R.**—The output from a dynamo is governed by its armature winding. As your machine was designed for a definite output, there is not much that could be done to increase its output, apart from increasing its speed, and this will raise the voltage. If you can run at twice its present speed, you may attain what you desire, but, of course, there will be no increase of current with the increased speed. The winding you refer to as a commutating field would be compensating coils and form a part of the constant voltage that the machine would give at varying speeds. This would be a feature of this style of dynamo.

### No. 9886.—Current demand of Motors
### N.C.S. (Bristol)

**Q.**—I have recently bought a ¼ h.p. single-phase, 230 V BTH induction motor. I find on starting it on or off load, there is a dipping of all the lights in the house, causing a nuisance to everyone but myself. The motor is fitted with an automatic cut-in, and out of the power when switched on and off respectively. I was wondering if a capacitor-start coil, or a sliding resistance would cure this dipping trouble?

**R.**—Your motor is of the ordinary induction-start type and will demand a very heavy current during the starting period, and as you have probably connected it to part of the house installation, this accounts for the drop in volts when you start up. A circuit should be taken right back to the point of supply by a separate switch-fuse. The starting performance can be improved by connecting the motor to have capacitor starting; this involves using a condenser in series with the starting winding. A capacity between 60 and 160 mfd. may be suitable. The working voltage of the condenser will be to 400 V. A correct capacity value cannot be given unless the inductance of the starting winding is known. Your best plan would be to write to the makers of the motor, who will advise you as to the correct condenser to use.

### No. 9885.—Rewinding a Generator
### H.W. (Marlborough)

**Q.**—I have a small motor generator which I propose to re-wind to use as a motor on 200 V a.c. I have removed the old winding from the armature, and one of the commutators. The armature core is 1⅞ in. diameter and 1½ in. long, and has 15 slots, with a 30 segment commutator. I would be grateful for your advice on the windings for this motor, shunt wound, to run at about 1,500 r.p.m. on 200 V, a.c.

**R.**—An electric motor to operate on a.c. cannot be shunt wound; it can operate only as a series wound motor. For a motor of the size you mention, a speed of 1,500 r.p.m. is much too low for the attainment of any useful power; a normal speed would be in the region of 8,000 to 10,000 r.p.m. If you decide to rewind the motor, a suitable procedure would be as follows: For the armature, coil span will be slots 1 and 7. The gauge of wire, No. 36 enamel single silk-covered copper wire. There will be 15 coils, each having two turns, then without cutting the wire, bring out a loop and continue winding in the same two slots, another 43 turns, and this completes one coil. Without cutting the wire, continue winding in slots 2 and 8 and so on right round the armature until all coils are in place. The end of the last section will connect to the start of the first section. The commutator bar connection will be to bars 1 and 2. Put the inner end of the first section on bar 1 and the outer end of this section on bar 2. Actually, the first loop will be connected to bar 2, then carry on with each bar until all ends are in place. The field coils may have 350-400 turns of No. 34 plain enamel-covered copper wire. Slot insulation may be to 8 Mil. thickness of leatheroid or other insulating material. As this is a high speed motor, a hard baking armature varnish should be used. Empire and cotton tape is suitable for the field coils.

### No. 9877.—Engine Balancing
### E.C. (Ambleside)

**Q.**—I am in possession of a vertical twin-cylinder engine which was originally fitted with cast-iron pistons. It has recently been rebored and fitted with aluminium pistons, and as it now vibrates rather badly, I would like to try and balance it, and would be very grately if you could tell me of the correct procedure. The engine cranks are at 180° and have large cast-iron balance weights bolted and revited on to the crankweb extensions.

**R.**—The balancing of an engine having cranks at 180° is a somewhat difficult proposition, owing to the fact that individual balancing of the two sets of pistons is necessary. We advise you to proceed as follows : Remove both sets of balance weights and ascertain, by rolling the crankshaft on knife edges, that it is in itself in static balance. The connecting-rods should then be weighed on two balances to obtain the weight of the little- and big-ends respectively. The pistons are also weighed and the amount of each balance-weight should then be equal to the weight of the big-end of the connecting-rod, plus half the weights of the little-end and the piston added together. This should be tested by attaching one balance weight only to the crankshaft, and ensuring that it balances the weight specified on the adjacent crankpin. Even when the greatest care has been taken to work out and assess these weights, some slight adjustment of the balance weights may still be required. Needless to say, the two sets of working parts should be of exactly equal weight, and the same applies to the balance weights.

### No. 9883.—Spinning in Copper
### W.G.A. (Ruislip)

**Q.**—I should like to make a number of cups for presentation as children's prizes, and am considering spinning them in copper. Would you please give me some advice on the methods of mounting and driving the blank when the point of contact is relatively small, as necessitated by the shape of the cup to be produced. Could it be driven without making a hole in the blank? Also, what is the correct procedure for operating the spinning-tool? Should one start from the centre and work outwards or vice versa? For a blank of about 2 in. diameter what is the correct rotational speed?

**R.**—The usual method of machining sheet metal for spinning processes, in cases where it is not permissible to drill a hole in the centre, is to use a pressure pad suitably shaped to grip the metal as firmly as possible and held in place by a ball- or roller-bearing type of running centre in the tailstock. In your case, it would be advisable to make the face of the pad slightly concave, as this would assist in pre-forming the centre of the work before the spinning operation. In this particular case, however, we do not see any disadvantage at all in drilling a hole in the centre of the cup, as this would facilitate attaching it to the column or pedestal. The method of using the spinning tool is to work from the centre outwards, and it is desirable to have a form of tool-rest in which pegs can be inserted to form a fulcrum to the tool, as considerable pressure and leverage are required, especially if the metal is of any substantial thickness. Spinning speeds vary considerably for different types of work, but we suggest that 300 r.p.m. would usually be suitable for a job of this nature.

### No. 9881.—Speed Reduction by Transformer
### T.M. (Belfast)

**Q.**—I have an ex-W.D. $\frac{1}{8}$ h.p. electric motor, speed 3,000 revs. I want to reduce the speed to 1,000 revs. Could you advise me whether it would be possible to do this by means of a resistance or transformer, and if so the most suitable type to use, and the address of a firm who could supply it? I should like to have two speeds, say 1,000 and 2,000, with a foot control.

**R.**—It is quite in order to reduce the speed of a series wound motor by means of a series resistance or a tapped transformer, but this will inevitably reduce the power of the motor very considerably. Of the two methods, the use of a transformer is the less wasteful, and we suggest that you could have a transformer with two tappings, one giving a normal voltage, and the other a suitably reduced voltage with a simple change-over switch which could be operated by a foot control as you suggest. It is impossible to give you exact particulars of the amount of resistance or reduction in voltage that will be necessary, as it will depend very largely on the particular characteristics of the motor, but we suggest that you could try dropping the voltage to about 150 if a transformer is used, or in the case of a resistance, using about 400 to 500 ohms in series with the motor.

### No. 9880.—Materials for the Road Roller Engine
### W.V.T. (Hayle)

**Q.**—I am contemplating using the "M.E." road roller engine for light stationary work at a speed of 750 r.p.m. for 1 hr. periods. Will you please advise me as to whether the standard gunmetal cylinder-head and aluminium piston are suitable, or will it be necessary to cast these in iron, and would you deem it a necessity to fit a governor; if so, will you please give me an idea for making same.

**R.**—The standard gunmetal cylinder-head originally specified for the "M.E." road roller engine is quite suitable for your purpose, but we should recommend cast-iron for the piston of an engine running at slow speed, in preference to one of aluminium, as it can be fitted to such closer clearance and will give much longer wear. A governor is very desirable for use on a stationary engine, and it would be possible to fit one on the engine shaft. This has been done by some of our readers, and a description of a governor incorporated in the engine flywheel was included in an article by Mr. R. L. A. Bell in the issue of December 30th, 1948. We would like to point out that 750 r.p.m. is a very slow speed for such a small engine, and although this particular engine will undoubtedly run quite well at that speed, it should not be expected to develop a great power. We should be inclined to recommend about twice this speed for light stationary work.

# PRACTICAL LETTERS

### The "M.E." Diary

DEAR SIR,—Recently we have read the reports of the International Power Boat Regatta at Derby. Well, I for one was most disappointed that I did not know of the event at Derby, as it was only 30 miles from my home.

I mention this because I would like to see added to the "M.E." Diary of forthcoming events, field-days of model aeroplanes, boats and cars, as this would open up a wide field for those who are regular readers of "ours," though they are not even "lone hands" but visitors.

Let us suppose that a friend of ours with no mechanical knowledge could get in touch with a competitor at one of these meets; he might even ask for the most embarrassing moment the competitor has had connected with his model? time taken to build?—to prepare for racing?—to maintain for each event?—What was the most difficult or delicate piece of mechanism in the model?

I mention these phrases because the answers might easily transform our visitor into a member of some club or other. Therefore, I would like to see all field-days of boats, cars and aeroplanes advertised in the Diary. A continuous reminder is better than no announcement at all.

Yours faithfully,

Leicester. A. G. PIPPER.

### Model Power Boat Silencing Problems

DEAR SIR,—As a member of a model power boat club which, in spite of observing the M.P.B.A. silencing regulations, still encounters many complaints from the local inhabitants, I shall be glad to know whether any other clubs or individual experimenters have carried out any research work or practical tests on silencers. The main difficulty, of course, is in silencing the two-stroke engines, particularly the 10 c.c. class. Four-stroke engines do not present such difficult problems. An interchange of ideas on this subject might help to produce a design which can be standardised by the M.P.B.A.

It appears to be an almost insuperable problem to silence an engine efficiently enough to satisfy the very critical local residents, although their houses appear to be so far away that the noise could hardly be really annoying, according to our standards. Even with the silencers at present fitted, we have to put up with a certain loss of power besides extra weight. Any attempt to reduce either the bulk or weight of the silencer is almost bound to reduce its efficiency. My own suggestion would be to fit an expansion chamber directly to the exhaust port of the engine, and fit a pipe leading to a normal type of silencer which, in order to cut down wind resistance, could be located on to the deck. This would reduce the exhaust pressure and noise without causing a lot of back pressure.

On some commercial engines, it is practically impossible to obtain a silencer or to fit one if it were obtainable, and I suggest that the neglect of any measures to silence such engines may have been partially responsible for the many complaints regarding engines which are encountered all over the country.

I would also like to ask if any readers know of a suitable stretch of water for testing model hydroplanes within reasonable travelling distance of South London, and far enough from human habitation to avoid causing annoyance by noise. I know of several ponds in the area, but they are not suitable for various reasons.

Yours faithfully,

Carshalton. E. A. WALKER.

### Screwing Dies

DEAR SIR,—We have taper, second and plug taps. Why never "plug" *dies*?

We often want a thread right up to the head of a bolt or a water-gauge plug, but the ordinary die leaves the last three or four "threads" tapered and very sketchy. Running the die down "upside down" is what we have to do, but it is a very unscientific and unsatisfactory makeshift.

Cannot we be offered "parallel" dies cutting a full thread throughout their length with no lead (beg pardon, "L.B.S.C." !).

What about it, makers of model engineers' tools?

Yours faithfully,

Hornchurch. CECIL AUDREY.

### Tiller Steering

DEAR SIR,—I see that Mr. Hughes replies to my letter on tiller steering. I did not by any means say that it was a usual type of steering. Yet it is not as unusual as Mr. Hughes would have people think, as I know of one firm alone who had 25 of these Wallis & Steevens rollers on the road not many years ago, besides a good many individual ones that I could name working at the present time. Messrs. Aveling & Porter fitted it on their upright-boiler tandem rollers, and Mclarens, of Leeds, built a number of traction engines with this type of steering; the only difference was that the tiller was under the boiler barrel, but it worked in the same way and was more commonly known as "rack" steering. So, with Robeys, that is four makers who have fitted it on some engines.

It may also be of interest to Mr. Hughes and many of your readers that Mclarens built a number of engines with the reversing lever and steering wheel on the same side.

Yours faithfully,

Liversedge. J. A. SMITH.

### Etching Glass

DEAR SIR,—I note in a November issue of THE MODEL ENGINEER that E.L.D., of Moreton, is looking for method and materials for glass

etching. On looking through my laboratory notebook I find the following, which I hope will prove useful to the gentleman concerned.

*Solution No.* 1. Sodium flouride, 21.25 grammes; potassium sulphate, 0.17 grammes; water (distilled), 568.25 millilitres (old term cubic centimetres).

*Solution No.* 2. Zinc chloride, 7.08 grammes; hydrochloric acid (fort), 36.5 millilitres.

Keep solutions separate until ready to use. Mix sufficient of No. 1 and No. 2 for job and apply to glass, leaving for 20-30 minutes. It is necessary, of course, to mask portions not to be etched by suitable varnish such as paraffin wax or bitumen paint.

Yours faithfully,

London, N. A. J. SIMPSON.

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### Home-constructed Refrigerators

DEAR SIR,—After browsing through some of the correspondence in your columns on this subject, it has occurred to me that I ought to write to you about my own effort. It has been running satisfactorily now for six months or so, and I imagine I have got over the teething troubles (and there were plenty of them).

I was able to utilise the castings of an old 'fridge compressor that had "had it" as far as bearings, crankshaft, seal etc., were concerned, and also I was able to modify an old cabinet from a 'fridge of the absorption type. This simplified construction considerably, but still left one or two major issues, and it is of these that I write, for I feel they may be of interest to you.

Regarding supplies of gas, I imagine most firms of refrigerator engineers would be glad to oblige, if one has a suitable cylinder for filling. I was lucky enough to obtain locally, for a few shillings, a pair of *ex*-R.A.F. emergency oxygen cylinders. These consist of a small steel cylinder, cylinder contents gauge (F.S.D. of same must be greater than 2,000 lb. sq. in., 100 lb. pressure hardly moves the needle), pressure reducing-valve, and a lovely screw-down valve with a semi-floating cone and bronze seating. The only modification necessary is to put the reducing valve out of action, either by removal and blanking off, or else just removing the needle. The diaphragm will stand the pressure all right. (By the way, one of these pressure reducing-valves came in very nicely for making a pressure-operated switch unit for my air compressor.) These little oxygen outfits hold about 1¾ lb. of methyl chloride. I believe Watson's of Aldeburgh, may still have them. The capacity may seem on the small side, but I learn that the modern commercial job of about 3½ cu. ft. averages about 12 oz. of liquid in the system.

I was tempted to modify the pressure reducing-valve assembly and use same as the expansion valve for the 'fridge. It worked after a fashion, but was not efficient, so I scrapped and bought a commercial valve. It was well worth while in the end.

As you may not be aware of the method used for filling small cylinders without resorting to a compressor, I think perhaps I should outline the process. The small cylinder is connected up to the supply, and filled with vapour. It is then disconnected, stood upright for a few minutes to settle, and then any air blown out of it. It is then popped into a 'fridge and rendered as cold as possible to drop the vapour pressure, so that when again joined to the large storage cylinder, and the latter is up-ended, liquid can flow in by gravity. It is usually necessary to cool down the small cylinder again half way to enable it to be almost filled.

One of my worst blunders was to obtain a tin of *ex*-Govt. silica gel for use in the drier. This stuff, as I learnt to my cost, has a high dust content, so fine that it even penetrated a felt pad. It soon went round the system, wrecked the expansion valve needle and seating, and soon after put paid to the compressor bearings. I had to blow off all the gas and start again. I learnt subsequently that a special grade is manufactured for 'fridge driers.

An *ex*-R.A.F. boost gauge (—8 lb. sq. in. to × 16 lb.) is very handy on the suction side. They can be obtained for 3s. 6d. or less. Mine has inadvertently stood full gas pressure, apparently with no ill effects, probably because they are diaphragm-operated instruments.

#### Using Arcton

One of your correspondents raised the possibilities of using Arcton with a modified *ex*-Govt. compressor. I cannot get any information as to whether or not this gas has any action on aluminium alloys. I do not think, even if this is not the case, that the Heywood compressor would be a good choice. Its capacity is too large, for one thing, and I imagine it would be very noisy. Recently I did a job for a friend of mine to a modern post-war 'fridge compressor (about 3½ cu. ft., I think it was, perhaps a bit more). This compressor was a massive job, about the size of a 250-c.c. motor-cycle engine. Anyway, I removed the head and measured up. It was only 1¼ in. bore by 1 in. stroke, but the cylinder walls were as thick as the bore! Manufacturers do not, these days, use up metal for fun, and the moral is that this type of compressor is almost inaudible when running.

If Arcton can be used with aluminium I imagine the BTH compressor could be adapted. I fitted one of these with a disc valve to the piston for my air compressor, but went over to a Heywood as volume was insufficient. I think the crankshaft would hardly be stiff enough to allow a packless gland (supposing it could be fitted) to work efficiently, although, of course, an outrigger bearing and a drive *via* the splines of the shaft, might be possible. I think the lack of piston rings would be an advantage. Most modern 'fridge compressors, I have been told, have lapped pistons of cast-iron, and ditto cylinder bores, with no rings. On the whole, I think it would hardly be worth while using an *ex*-Govt. compressor for the job. You want plenty of metal around, and a large oil reservoir in the crankcase.

Many minor snags arose in the building of my 'fridge; most of them should have been obvious to me at the time, but I'm afraid I only learnt by bitter experience, which after all, teaches well in the long run.

Yours faithfully,

Ipswich. C. M. JONES.